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[OFFICIAL NOTICE.]

Thirty-Second Annual Meeting, New England Association of Gas Engineers.

NEW ENGLAND ASSOCIATION OF GAS ENGINEERS,
OFFICE OF THE SECRETARY,
NEW BEDFORD, MASS., Feb. 5th, 1902.

The Thirty-second Annual Meeting of the New England Association of Gas Engineers will be held in Boston, February 19 and 20, 1902. The sessions will be held in the Parker House, corner of Tremont and School streets; but the headquarters will be in Youngs' Hotel.

The following papers have been arranged for:

"The Advantages of the Card System in the Gas Ledger," by Mr. A. M. Barnes, Cambridge, Mass.

"House Piping," by Mr. C S. Griswold, Meriden, Conn.

"Coal Gas Treatment," by Mr. A. B. Slater, Jr., Boston, Mass.

"Distributing Artificial Gas at High Pressure in a Suburban District," by Mr. George F. Goodno, Waukegan, Ills.

"Some Details in the Operation of a Lowe Water Gas Set," by Mr. C. F. Leonard, Fall River, Mass.

"Building Foundations for Steel Holder Tank on Quicksand," by Mr. C. A. Learned, Meriden, Conn.

Reports from standing Committees on "Selling Gas" and on "Electrolysis."

The following questions have so far been sent to the Question-Box:

"Has the licensing of gasfitters in Boston proved a benefit to the Gas Companies in Boston; and would the Boston Companies recommend the passage of a State law requiring all gasfitters to be licensed?"

"Why not have meter unions with ground joints, same as regular brass unions, thus doing away with washers, loose nuts, etc.?"

"What is the smallest size of purifier that can be used satisfactorily in water gas manufacture, making 1,000 cubic feet per run of 4 minutes and 5-minute blows?"

"Can oxygen be made cheap enough to use in the oxide purification?"

"What are the advantages in passing the water gas through separate purifying apparatus in works making both coal and water gas?"

Members having other questions are asked to send them in as early as possible, so that provision may be made toward answering them.

Application blanks for membership may be obtained of the Secretary.

Membership badges and copies of the Proceedings for 1900 and 1901 may be obtained at the meeting.

Members who have not yet paid their dues will confer a great favor on the Secretary by remitting before the annual meeting.

The members will dine as usual at Youngs', on Wednesday evening, Feb. 19th.

All friends of the Association are cordially invited to attend the meeting.

N. W. GIFFORD, Sec'y.

[OFFICIAL NOTICE.]

First Annual Meeting, Wisconsin Gas Association.

RACINE, WIS., Jan. 15th, 1902.

The First Annual Meeting of the Wisconsin Gas Association will be held in Madison, Wis., on Wednesday and Thursday, the 12th and 13th days of February. The headquarters of the Association will be at "The Park," where accommodations can be had at the rate of $3 per day, and rooms with baths for $4 per day.

Unless advised to the contrary the Association meetings will be held in "The Park."

HENRY H. HYDE, Secretary,
Wisconsin Gas Association.

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[Official Notice.]

Ninth Annual Meeting, Michigan Gas Association.

Michigan Gas Association,
Office of the Secretary,
Ann Arbor, Mich., Jan. 23, 1902.

To the Members of the Michigan Gas Association: The Ninth Annual Meeting of the Michigan Gas Association will be held in Kalamazoo, Mich., on Wednesday and Thursday, February 19 and 20. The headquarters of the Association will be in the Burdick House, where a rate of $2.50 per day has been made. As hotel facilities are somewhat limited better accommodations can be secured by writing in advance. A good programme will be presented, part of which will be a lecture, by Mr. E. D. Campbell, Professor of Analytical Chemistry, University of Michigan, on "The Function of Original Research in a Technical Education."

Henry W. Douglas, Sec'y.

[Official Notice.]

Wrinkle Department—Ohio Gas Light Association.

Ohio Gas Light Association,
Office of the Secretary,
Delaware, O., January 29th, 1901.

To the Members of the Ohio Gas Light Association: The Editor of the Wrinkle Department, Mr. E. E. Eysenbach, Superintendent, the Columbus Gas Company, Columbus, O., desires it known that those who have contributions to offer for publication in this valuable division of the Association's proceedings should have them in his hands not later than February 15th.

It is earnestly hoped that the fraternity will not be backward in sending Wrinkles to Mr. Eysenbach.

T. C. Jones, Sec'y.

BRIEFLY TOLD.

The Association Meetings.—Our official notices show that the gas men throughout the country are up and doing in the instance of their annual meetings. The first Association to convene is the Wisconsin Gas Association, whose members will assemble in the Senate Chamber of the State House, Madison, Wis., on Wednesday and Thursday of this week. It is worthy of note that this will be the first annual meeting of the Association. A good programme, some of the details of which were printed in the Journal for last week, has been arranged. The Thirty-second Annual Meeting of the "mother of them all"—the New England Association of Gas Engineers—will be held in the Parker House, Boston, on the 19th and 20th insts., and Secretary Gifford's current official notice regarding what is to be done in and out of the sessions is so complete that comment on it is unnecessary, save to remark that the programme is fully up to the high standard which has been the record of the New England gas men. We might further add that the current of gossip points to a rousing attendance at the meeting, which happening is the best reward that can be given to President Learned, Secretary Gifford and the Committee of Arrangements for their untiring and successful work in "getting ready for the clans." The Michigan Gas Association holds its Ninth Annual Meeting in Kalamazoo, Mich., the dates of the sessions being identical with those named for the New England meeting. It is regrettable that such clash occurs, but as the districts covered by the respective bodies are far apart the clash is more apparent than harmful. As with the other Associations the Michigan's bill of fare is wholesome and appetizing, and President Doty, Secretary Douglas and their aids look forward to an attendance that will in every sense thoroughly represent the gas industry of Michigan, the growth of which in the last 10 years has been nothing short of marvellous.

Notes.—Mrs. Julia E. B. Brick, widow of Joseph K. Brick, who 50 years ago was about as prominent a member of the gas profession as could then be named—for that matter his prominence continued to the time of his death, sometime in the early seventies—died at her home in Brooklyn, N. Y., the morning of the 3rd inst. She was in her 83rd year.——The annual meeting of the New Amsterdam Gas Company will be held at 340 Third avenue, New York, at noon of the 6th prox. ——The new plant at Steelton, Pa., has been completed.——It is understood that the selling rate at Ann Arbor, Mich., will be cut to $1 per 1,000 by April 1st—a concession of 25 cents per 1,000.

Metallic Joints for Steam, Air and Water: Also Quick Opening Valve Suitable for Gas Works, etc.

The joints here shown, the sketches and description of which are furnished by Mr. George Maut, of Camden, N. J., are modifications of a system introduced in England, in 1868, for the self-sealing lids of gas retorts when the pressure does not exceed an inch of water.

In Fig. 1 is shown a metallic joint 18 inches in diameter. It has a pewter seat. This type of joint has been working at a regular steam pressure of 90 pounds per square inch, and has been opened and closed about every five minutes. It is found after three months' use that the pewter swells upwards, but by the aid of a soldering iron it is smoothed over again and ready for use, new material being unnecessary. Wherefore this type of joint is not only most economical and durable but reliable.

In Figs. 2 and 3 the same kind of joint is used, but in this case is illustrated rings of a filter press, which are made from 12 inches to 48 inches diameter, and subject to air and water pressures up to 1,000 pounds per square inch, the filters being opened as required, sometimes once in an hour, at other times once in 12 hours. The conditions for the renewing of the joint are the same as those mentioned in the case of Fig. 1.

The pewter seat can be placed on the movable part of Fig. 1, if desired. It will be seen this type is most suitable for pump doors, covers, etc., and especially so throughout sugar works, where large doors are frequently in use that have to be opened and closed several times a day. The saving of heavy rubber joints, or additional rings of other material, will be found most economical.

In Fig. 4 is shown a type of joint for flanged pipe connections. Flanges may be loose and screwed on as usual, and if the faces of loose flanges are cast on a chill no machine work is necessary, and a perfect joint under all conditions and pressures is obtained. A test of 1,000 pounds pressure per square inch has been applied with this type of joint, and was perfectly tight. The pewter seat in this type is unnecessary, and the expansion and contraction in a line of pipe offer no inconvenience. The diameters of flanges can be reduced from the ordinary size if desirable, which will permit the bringing of the bolts closer to the joint line.

In Fig. 5 is shown another type of joint the special feature of which is that pipes of parallel cylinders can be used, dispensing with socket and lead. The joint is formed by wrapping one or two layers of burlap and red lead around the two ends of pipes to be jointed; an open ring of wrought iron is then brought over the burlap, the two ends of the ring being scarfed, when the clips can then be bolted up, one pair or two halves only being necessary. This makes an absolutely tight joint. The width of the clips is slightly more than the depth of a socket.

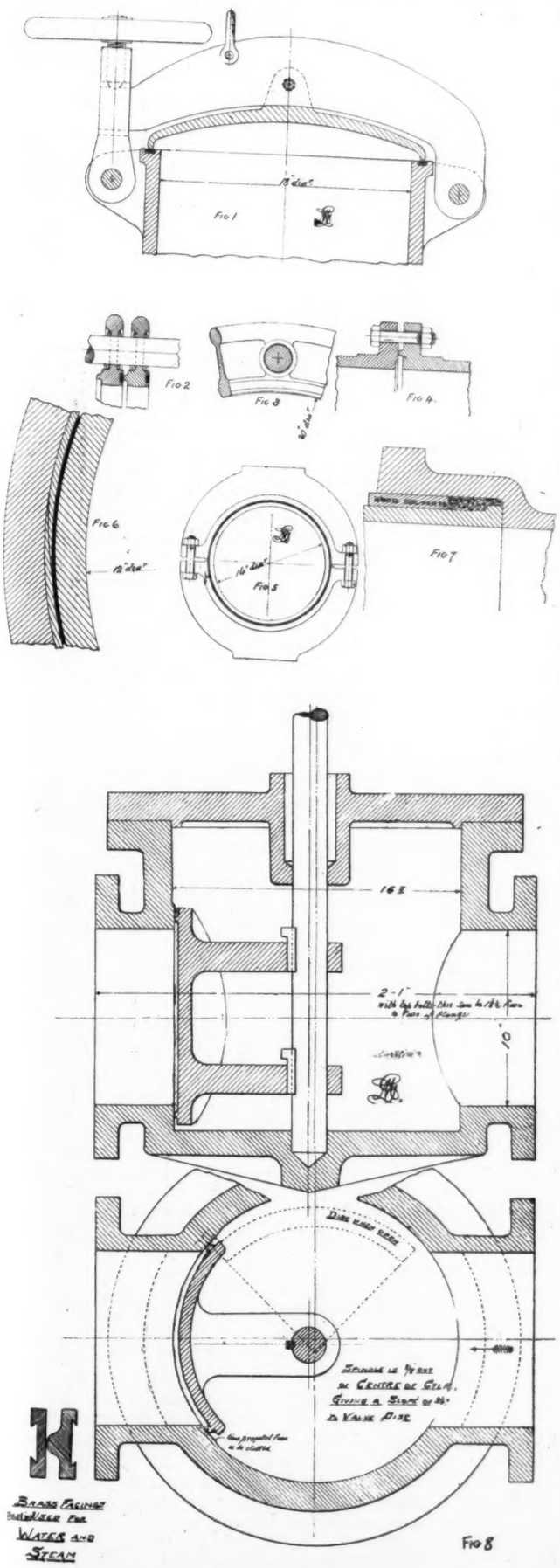
Fig. 6 shows another distinct departure in pipe jointing, and like that in Fig. 5, is without socket or lead. The ends of two pipes are wrapped as the one previous, when the cast iron collar is poured from a ladle supplied from a portable cupola, as in use for street car track joints, the collar being poured into a light chill mould, the collapsible ring allowing for the proper contraction to take place. The wrought iron ring being about $\frac{1}{8}$-inch thick, prevents any injury to the burlap and lead.

It is a well known fact that a collar of cast iron cannot be cast around a pipe without fracture on cooling, whereas by the use of a collapsible ring this is permitted. The ring is scarfed at each end, as shown.

In Fig. 7 is shown the joint with an ordinary socket. After the pipe is placed within the socket the yarn is calked in the ordinary manner, and in place of lead a series of wood segments are driven in. These will be found to be inexpensive and much cheaper and more durable than lead. It is a fact not widely known that it is the yarn or hemp that makes the tight joint and not the lead, hence all water mains have tight joints and vice versa with gas mains. That lead expands but does not contract can readily be proved by anyone taking the trouble. Again, the yarn in a water main joint is always swollen by the water it is in contact with; on the other hand in a gas main it perishes from dry rot, and so leakage takes place.

In Fig. 8 is shown a type of valve most suitable for gas works, for blow off cocks for boilers, and numerous other locations.

The peculiarity of features of this valve is that the valve spindle and valve are eccentric to the cylinder, the spindle being placed about $\frac{3}{8}$ inch out of center, so that in opening the valve the contact with the cylinder is immediately released, consequently it is easily operated and also quickly. For water and steam of low pressures, brass seats or facings



10-Inch Gas Valve, System Mant.

are cast in the cylinder and valve. The dotted lines show position of valve when open, leaving a full and clear passage. The size shown is 10 inches diameter. A valve made upon these lines for the purposes indicated will be found most economical and serviceable.

Comparison of Cost of Operating an Iron Smelting Plant by Gas Engines Using Waste Blast Furnace Gas, and by Gas Fired Boilers and Steam Engines.[1]

Power derived from blast furnace gases used in gas engines originated in Europe, but as yet very little has been done in this direction in this country for producing it. Several plants are now running successfully and with great economy in Europe.

Some of the difficulties which the iron masters encountered were: First, that the gases were too poor to be ignited in an engine cylinder; second, the heating value of the gases was too low; third, the gases vary too much in pressure and composition, and, lastly, the chief difficulty to overcome was the great amount of dust in the gas, which would collect and tend to clog the exhaust valves and working parts of the engine. These difficulties are being overcome by the engineer, so that with the necessary precautions, the problem is working out successfully.

It is now found that the gas, owing to its leanness, permits high compression in the engine cylinder, and owing to this fact no difficulty is found in its ignition. The low heating value of the gases has proved itself to be an advantage, as the higher the compression, the greater the economy. Owing to the irregularity of the flow of gases in a blast furnace, it is not safe to depend upon a single furnace for supplying gas to run gas engines, unless an auxiliary gas producer is used. This objection, however, arises in any form of steam plant fired by waste gases, and the boilers are, therefore, always so installed as to be fired when necessary with other forms of fuel.

Little difficulty has been met with, owing to differences in composition, as these differences are dependent upon the relative proportions of fuel, ore and fluxes used, which are fairly constant for a given furnace. The dust is removed by passing the gases through scrubbers and purifiers, and the necessary cooling accomplished by leading the gases through pipes and spraying cold water upon them.

With these precautions, the gases on reaching the engine cylinder contain little or no dust. The amount of dust varies according to the kind of charge used in the furnace.

It is estimated that about 400 cubic feet of waste gas are required when the gases are burned under a boiler to produce 1-horse power per hour at the engine, and the result of the following boiler test confirms this estimate.

On the other hand, according to the latest results from actual tests, it has been found that about 105 to 110 cubic feet of gas are required for 1-horse power per hour when ignited in a gas engine cylinder, This would show the economy to be 4 to 1 in favor of the gas engine; the result of the test herein described shows a theoretical economy of 7 to 1.

General Plan of Experiments.—The test was made in May, 1901, at the blast furnace of the Warwick Iron and Steel Company, of Pottstown, Pa., to determine the horse power of the boilers, the amount of gas used per hour per horse power, the calorific value and the analyses of the gases from the furnace. Having obtained the above data, the amount of horse power which could be produced by using the furnace gases in gas engines was calculated, and a comparison was made in the cost of installation of gas engines with the cost of condensing steam engines and boilers.

The principal practical results deduced from the test are as follows:

I.	Horse power developed by present gas fired boiler plant	1,150 H. P.
II.	Efficiency of boilers	58.2 per cent.
III.	Calorific value of gas per cubic foot at 60° F.	118 B. T. U.
IV.	Waste gas at 60° F. used by boilers per hour	646,910 cu. ft.
V.	Horse power developed by gas engines using 646,910 cu. ft. per hour	7,634 H. P.
VI.	Horse power available for sale, allowing for running of plant and emergency	6,000 H. P.
VII.	Cost of gas engine plant for running furnace	$82,800
VIII.	Cost of present steam engine and gas fired boiler plant	74,750
IX.	Total cost of installation of gas engines for running the furnace and generating 6,000-horse power for sale	526,280

1. Graduation Thesis, 1901, Stevens Institute Technology, by Wm. M. Chatard, M.E., Henry J. Botchford, M.E., and Emley M. Holcombe, M.E.

X. Amount realized from sale of 6,000-horse power at $20 per year per horse power $120,000

XI. Allowing 10 per cent. for depreciation, there would be a profit of 13 per cent. on the money invested.

Description of Plant.—The furnace has been in blast since December 16, 1896, producing from 130 to 150 tons of pig iron per day, from which excellent grades of foundry and mill iron are obtained. Four casts are made each day at intervals of six hours. The furnace is 70 feet high with a 15-foot bosh, 10-foot hearth, and has 7 tuyeres around the zone of fusion. The weighed ore is raised to the top of the furnace in barrows by means of an Otis hoisting engine. The top of the furnace is closed by a single bell and hopper, the bell being raised and lowered by steam power. No provision is made to prevent the escape of the gas during the time that the bell is being lowered.

There are four Hugh-Kennedy stoves for heating the blast, three being 60 feet in height and one 80 feet high. These stoves supply a constant hot blast to the furnace at a pressure of 6 pounds per square inch and at an average temperature of 1,200° F.

The blast furnace gases are led from the top of the furnace to the stoves, and to the boilers by means of two down-comers, of which the gases to the stoves pass through a dust catcher and a dust washer, thereby freeing them of their dust.

The boilers of this furnace are of the Elephant type without tubes, and were installed 25 years ago. They are arranged in 3 batteries; each battery, containing 3 boilers, is inclosed in a brick setting.

The blast furnace gas from the down-comer enters the furnace of each boiler through nozzles, in which are regulating valves to govern the supply of gas. The gases are ignited in the combustion chambers and pass under the boilers to the stack. Under ordinary circumstances, no fuel other than the gases is required to maintain combustion. The steam from all the boilers is led into one main.

The vertical condensing blowing engine for the blast was built in 1888 by the Weimer Machine Works, Lebanon, Pa., and, at the time of the test, had been running 5 years without repairs. The air cylinder of this engine is double acting and discharges about 20,000 cubic feet of air per minute according to the number of revolutions of the engine. Two Worthington duplex pumps, 20″×17′×15″, furnish cooling water for the furnace. A Gardner duplex pump supplies water to the 3 boilers.

The composition of the gas entering and leaving the boiler furnaces was determined simultaneously by use of the Hempel and Orsat-Muencke gas analyzing instruments, analyses being made as often as possible throughout the time of the test. The temperature of the fuel gas was determined by thermometers and the pressure measured in inches of water. The temperatures of the combustion chambers and of the exit gases were determined by use of copper ball pyrometers and by Le Chatelier's pyrometers.

Results Deduced from the Test of Boilers and Blowing Engine.

Table I.—*Test of a Weimer Blowing Engine.*

An average is taken of readings of the mean effective pressures obtained from sets of indicator cards taken every half hour.

At time of test, engine had been running five years without repairs and cards showed little or no cut-off.

Data.

Bore of steam cylinder, inches	54
Bore of air cylinder, inches	108
Stroke of pistons, inches	72
Diameter of piston rod, inches	7⅛
Length of test in hours	12
Number of revolutions per minute	28
Average pressure of steam in main near engine, in pounds per square inch	58.6
Barometric pressure, in inches of Hg	29.59
Average mean effective pressure from indicator cards, pounds	29.7
Number of cu. ft. of air displaced per minute	20,000
Indicated horse power of steam cylinder	680

Table II.—*Tests of Three Sets of Boilers.*

(The boilers are all connected to one steam main.)

1. Type of boiler	Old cylinder.
2. Length of test, in hours	12
3. Kind of fuel burned	Waste blast furnace gas.
4. Average steam pressure, in pounds per sq. in.	58.6
5. Average pressure of inlet gases, in inches of water	2.58
6. Average temperature of feed water, in degrees of F.	132.
7. Average temperature of air surrounding boiler houses:	
Wet bulb	57.4
Dry bulb	68.5
8. Average temperature of entering gases in degrees F.	602.
9. Average temperature of fires under boilers, in degrees F.	1,800.
10. Average temperature of flue gases, in degrees F.	970.
11. Average barometric pressure, in inches of mercury	29.59
12. Total weight of water evaporated during test, in pounds.	428,247
13. Equivalent evaporation from and at 212° F.	476,657
14. Equivalent evaporation from and at 212° F., in pounds, per pound of combustible	.80
15. Horse power of boilers, according to standard recommended by the American Society of Mechanical Engineers, *i. e.*, 34½ pounds of water evaporated per hour per horse power from and at 212° F.	1,150
16. Efficiency of boilers, per cent.	58.2

Table III.

1.—*Average Composition of Fuel Gases:*

	By Volume.	By Weight.
CO_2	7.2	10.47258
CO	29.5	27.30343
N	60.4	60.60980
CH_4	2.0	1.05872
O	.5	.52898
H	.4	.02649
	100.0	100.00000

2.—*Average Composition of Flue Gases:*

	By Volume.	By Weight.
CO_2	9.2	12.7434
O	10.6	10.6796
CO	.7	6.1294
N	79.5	70.4496
	100.	100.000

Heat Balance.

Let Q = heat absorbed by the boiler, or evaporation from and at 212° F. × 966.

X = total number of pounds of entering gas.

A = number of pounds of air per pound of gas (gas to air ratio).

T_1 = temperature of fire in degrees F. = 1,800.

T_2 = temperature of stack in degrees F. = 970.

P = percentage of generated heat radiated, say 5 per cent. for these boilers.

R = calorific power of the gas (B. T. U. per pound).

= (1 + A) spec. heat ($T_1 - T_2$) − (.05 R) per pound gas, or for X pounds gas,

$$\text{Total } Q = X \times \left\{ [(1 + A) \text{ spec. heat } (T_1 - T_2)] - .05\ R. \right\}$$

$$X = \frac{\text{Total } Q}{[(1 + A) \text{ spec. heat } (T_1 - T_2)] - .05\ R}$$

$$\text{Total } X = \frac{\text{Equiv. evap. from and at 212° F.} \times 966}{[(1 + A) \times .25\ (T_1 - T_2)] - .05\ R} \quad \text{.....(a)}$$

Deduction for, first, hygrometric moisture in air = per cent. (pounds) × A × .48 ($T_2 - t$) and, second, for loss due to weight of water formed by combination of hydrogen in the gas with oxygen =

$$\text{Per cent. } H \times 9 \times \left\{ (212 - t) + 966 + .48 \times (t - 212) \right\}$$

Formula (a) becomes:

$$\text{Total } X = \frac{\text{Equivalent evaporation from and at 212° F.} \times 966}{\left\{ \left[(1 + A) \times .25\ (T_1 - T_2) \right] - .05\ R - \left[\text{per cent. (pounds)} \times A \times .48\ (T_2 - T) \right] - \text{per cent. } H \times 9 \left[(212 - t) + 966 + .48 \times (T_2 - 212) \right] \right\}} \quad \text{.....(b)}$$

I.—*Water Evaporated from and at 212° F.*

t = temperature of feed water = 132° F.

H = total heat of steam at boiler pressure above 32° F = 1,175.2.

W = total amount of water evaporated = 428,427 pounds. Equivalent evaporation from and at 212° F.

$$= \frac{W \left[H - (t - 32) \right]}{966}$$

$$= 428{,}247 \left\{ \frac{1175.2 - 100}{996} \right\} = 476{,}657 \text{ pounds.}$$

Total heat Absorbed by Boiler = Q.

$Q = 476{,}657 \times 966 = 460{,}451{,}174$ B.T.U.....(c)

II.—*Number of Pounds of air Per Pound of Gas = A.*

$$A = \frac{\text{per cent. carbon in combustible} \times 7 \times N \text{ in flue gas}}{.77 \times 3 \times (CO_2 \text{ in flue gas} + CO \text{ in flue gas})}$$

Per cent. carbon in 29.5 CO (Table III., Item 1) =

$$\frac{12}{12+16} \times 29.5 = .4286 \times 29.5 = 12.6437.$$

Per cent. carbon in 2.0 CH_4 (Table III., Item 1) =

$$\frac{12}{12 \times 4} \times 2 = .75 \times 2 = 1.5.$$

Total per cent carbon in combustible fuel gas = 14.1437.

Substituting,

$$A = \frac{(14.1437 \times 7 \times 79.5)}{.77 \times 3 \times (9.2 + .7)} = \frac{7870.96905}{2{,}286.9} = 3.44 \text{ lbs. of air per lb. of gas.}$$

$(1 + A) = 1 + 3.44 = 4.44.$

(.25 = specific heat of products).

$(1 + A) \times .25 = 4.44 \times .25 = 1.11.$

$(1 + A) \times .25 \times T_1 - T_2) = 1.11 \times (1{,}800 - 970) = 921.3$ B.T.U.....(d)

III.—*Calorific Power of the Gas, B.T. U. per Pound.*

Hydrogen (H) per pound.....62,100 B.T.U.
Carbonic oxide (CO) per pound..... .... 4,476 "
Methane (CH_4) per pound.....23,851 "

$$R = \left\{ 62{,}100\,H + 4{,}476 \left[CO \text{ (fuel)} - CO \text{ (flue)} \right] + 23{,}851\,CH_4 \right\}$$

$$R = \left\{ (62{,}100 \times .0002649) + 4{,}476. \times (.273034 - .061697) + (23{,}851 \times 0.10587) \right\}$$

$R = 16.449 + 945.946 + 252.513.$

$R = 1{,}214.91$ B.T.U.

The pound of gas enters the furnace at a temperature of 534° F. (602° — 68°) above temperature of the boiler room.

The available heat from this source, taking the specific heat of the gas at .24 is $534 \times .24 = 128$ B.T.U.

The total heat available per pound of entering gas is, therefore, 1,214.9 + 128 = 1,343 B.T.U.

Percentage of generated heat radiated from boilers

$= .05\,R = .05 \times 1{,}343 = 67.15$ B. T. U.....(e)

IV.—*Hygrometric Water in Air Entering Furnace* = per cent. (lbs.) of moisture $\times A \times .48\,(T_2 - t)$.

Specific heat of steam at constant pressure = .48 B. T. U.

$A = 3.44$ $T = 970°$ F. $t = 68.5°$ F.

Substituting, we have,

$.005 \times 3.44 \times .48\,(970 - 68.5) = 74.34$ B. T. U.....(f)

V.—*Loss Due to Weight of Water Formed by Combustion of Hydrogen in the Gas with Oxygen* = per cent. (hydrogen by weight) $\times$

$$9 \left\{ (212 - t) + 966 \times .48\,(T_2 - 212) \right\} =$$

$$.0002649 \times 9 \left\{ (212 - 68.5) + 966 + .48\,(970 - 212) \right\} =$$

3.513 B. T. U.....(g)

Substituting (c), (d), (e), (f) and (g), in (b)

$$X = \frac{460{,}451{,}174}{921.3 - (67.15 + 74.34 + 3.513)}$$

= 593,135 pounds of gas entering in 12 hours, or, 49,430 pounds per hour.

Reduction Formula: Pounds of Gas (actual) to Cubic Feet of Free Gas.

1 lb. of H	occupies	178.2	cu. ft.	at 32° F.	and	29.92 ins. pressure.
1 lb. of O	"	11.2	cu. ft.	"	"	"
1 lb. of N	"	12.7	cu. ft.	"	"	"
1 lb. of CO	"	12.8	cu. ft.	"	"	"
1 lb. of CO_2	"	8.1	cu. ft.	"	"	"
1 lb. of CH_4	"	22.3	cu. ft.	"	"	"

Multiplying these values by their respective percentages in weights from Table III., Item 1, we have that 1 pound of this gas occupies 12.3831 cubic feet at 32° F. and 29.92 inch pressure.

Correcting for temperature and pressure of test (Table II., Items 5, 8 and 11) we have,

$$\frac{V P}{T} = \frac{V' P'}{T'}$$

$$V' = \frac{12.3831 \times 29.92 \times 1{,}094}{492 \left\{ 29.59 + \frac{2.85}{13.6} \right\}} = 26.9$$

One pound of this gas occupies 26.9 cubic feet at 602° F. and a pressure of 29.58 inches of mercury. Therefore, 49,430 pounds per hour $= 49{,}430 \times 26.9 = 1{,}329{,}670$ cubic feet per hour at 602° F.

CALCULATIONS FOR TABLE II.

Item 14. Equivalent evaporation from and at 212° F. per pound combustible $= \frac{476{,}657}{593{,}135} = .80$

Item 15. Horse power of boilers, according to standard recommended by the American Society of Mechanical Engineers, *i. e.*, 34½ pounds of water evaporated per hour from and at 212° F. $= \frac{476{,}657}{12 \times 34.5} = 1{,}150$

Item 16. Efficiency of boilers

$$= \frac{\text{Item 14} \times 966}{\text{Heat balance, Item (111)}} \times 100 = \frac{.8 \times 966 \times 100}{1{,}343} = 58.2 \text{ per cent.}$$

Calorific value of gas per cubic foot at normal pressure and temperature = 125 B. T. U.

Calorific value of gas per cubic feet at 60° F. =

$$125 \times \frac{492}{492 + (60 - 32)} = 118 \text{ B. T. U.}$$

Cubic feet of gas per hour at normal temperature and pressure = 612,097, which is equal to 646,910 cubic feet at 60° F.

B. T. U. per hour at 60° F. = $646{,}910 \times 118 = 763{,}355{,}000$ B. T. U.

One-horse power $= \frac{33{,}000}{778} \times 60 = 2{,}545$ B. T. U. per hour.

At an efficiency of 25.5 per cent. the number of B. T. U. per horse power hour would be, $\frac{2{,}545}{.255} = 9.980$. B. T. U. required per horse power hour.

Assuming, therefore, 10,000 B. T. U. per brake horse power hour, we have 7,634-horse power hour as the total generated by the gas engine installation.

Allowing 1,150-horse power for blowing and other purposes in connection with the blast furnace and 483-horse power for emergency, we have as total horse power available for sale, *i. e.*, for lighting and power purposes, an amount at least equal to 6,000-horse power.

This may be sold at $20.00 per year per horse power and would yield an income of $120,000.

Capital invested in gas engine plant over and above cost of installing old blowing plant of same size and its auxiliaries = $526,280. Allowing 10 per cent. for depreciation, 13 per cent. would still be made each year on the investment as $120,000 is 23 per cent. of $526,280.

ESTIMATES.

I.—*Gas Engine Plant for Furnace Uses Only.*

Three 400-horse power gas engines (blowing).....	$60,000
Two 200-horse power gas engines (high speed).....	20,000
Two 200-horse power generators.....	2,800
Gas scrubbing arrangement charged in III.....	
Total.....	$82,800

II.—*Old Engine and Boiler Plant for Furnace Uses Only.*

Two blowing engines.....	$50,000
Three sets of boilers.....	24,000
Two feed water pumps.....	750
Total.....	$74,750

III.—*New Power Plant (exclusive of furnace uses).*

Seven 1,000-horse power gas engines and dynamos.....		$398,000
Two cooling water pumps with electric motors, (jacket water).....		6,230
One gasholder.....		10,000
Two gas washers (water).....		2,000
Two gas scrubbers (sawdust).....		2,000
Buildings.....		50,000
Labor and fittings.....		50,000
New plant.....	$82,800	
Old plant.....	74,750	
Difference.....		8,050
		$526,280

Therefore, total cost of complete gas engine and blowing installation, for running the furnace, supplying power to plant and generating 6,000-horse power for sale amounts to $601,030.

Greyson De Schodt's Incandescent Gas Burners.[1]

At the meeting of the Dutch Association of Gas Managers last summer, M. Greyson de Schodt read a paper on "Intensive Gas Lighting by Incandescence." It was devoted mainly to a recapitulation of the leading principles underlying this system of illumination, and their application to the production of the burners with which the name of the author is associated. We have received a print of the paper in pamphlet form from M. Greyson, and take therefrom the following particulars:

The growing demand for more light which has been a prominent feature of the progress of the gas industry during the past decade has rendered the ordinary incandescent burner too small a unit. The multiplication of these units, or light centers, being inconvenient in practice, there has been a very decided movement in the direction of employing high power lighting. Moreover, the increased use of the electric light has stimulated gas managers to compete with it by the introduction of economical burners. The author has been engaged for several years in endeavoring to augment the light giving capacity of incandescent gas burners; and the results of his labors have served as a basis for the construction of his appliances. An examination of the systems generally in use led him to the conclusion that the maximum luminous intensity is not obtained with the hottest flame, but with the flame which leaves available a certain quantity of carbon in a nascent state in the vicinity of the mesh of the mantle; in other words, that it is this carbon which plays the predominant part—it may be either calorific or chemical—in luminescence. It is evidently not the former, as the experiments of Professor Lewes show that the temperature of the outer zone of an atmospheric flame with a green cone is 1,511° C.; while Dr. Bunte estimates at 2,000° C., the temperature reached by the fabric of the mantle. It must be concluded, therefore, that it is chemical, and that it takes place only when the elements are present in definite proportions—that is to say, when a certain quantity of carbon in the flame acts upon a certain quantity of oxide of cerium in the mantle. It is this condition of things, in combination with the calorific action developed by the flame, that has produced the luminous effects which have so completely revolutionized the gas industry.

The first application of this principle to intensive gas lighting by incandescence was made by the author in the production of his high pressure burners. Here, by means of special arrangements, the primary combustion was effected by considerably augmenting the proportion of air drawn in. The result was that, owing to the richness of the mixture in oxygen and nitrogen, if the flame was hot it was likewise very short, and the available carbon elements were present in too small a quantity to produce the chemical reaction of incandescence. Consequently, in endeavoring to effect this, if a mantle having an ordinary surface was used, it was necessary to burn three times as much gas as if the primary mixture were a little oxygenated. A very good result was obtained, as the great primary heat developed (the flame being at a very high temperature) had the effect of driving the hot gases with some force against the mantle, which facilitated the oxidation of the carbide of cerium formed.

The experiments made by Professor Lewes with the Greyson high pressure system were very satisfactory, inasmuch as, with a consumption of 10.63 cubic feet of gas, a light of 322 candles was obtained. The drawback to the system, however, lay in the fact that, the gas being generally supplied to the consumers at a lower pressure than was required for the burner, special appliances were necessary for increasing it; and for private houses their installation presented certain inconveniences. The application of the author's "Rational" high pressure system also has, for this reason, been confined to large industrial establishments; and therefore he has been led to apply to ordinary lighting, at the usual pressures, the principles embodied in that system. Owing to the smaller quantity of air drawn in, the primary combustion is not so complete. The result is that the amount of disposable carbon is greater, and that, in order to have an intensive burner, a very much larger mantle has to be used—one, moreover, in which the cerium is present in proportion to the quantity of carbon in the nascent state. In addition, special arrangements have to be made to bring on to the mantle, with a certain amount of force, the air required for secondary oxidation. The application of these principles led to the production of the author's low pressure burners, two of which are shown in the accompanying illustrations.

Fig. 1 is a No. 3 burner, one-half the natural size. From a single jet injector the gas passes into the chamber *A*, which is perforated with holes obliquely in a direction parallel with the cone of the injector. The stream of gas draws round it a sheath of air which comes in contact, at the upper part of the chamber, with a parabolic surface *B*, the focus of which is at *C*. The chamber is surmounted by a convergent divergent cone, above which is a piece of wire gauze supporting the mantle—a closed gallery and a perforated chimney completing the appliance. The action of the burner is as follows: The air sheathed jet of gas strikes the parabolic top of *A*, and a whirling motion is set up, which brings the elements together. The effect of this movement would be to impede the passage of the mixture, were it not for the fact that the contracted portion of the cone accelerates the speed of the mass. On reaching the wider portion, it expands proportionately with the heat of the burner, and reaches the space above the gauze with its elements well combined. The air holes are so arranged that the mixture above the gauze shall not be so rich in oxygen as to cause complete combustion, notwithstanding the relatively high temperature. The result is that some of the hydrocarbons are imperfectly decomposed, and carbon in the nascent state is still disposable under the fabric of the mantle. The closed portion of the gallery causes streams of air to strike the surface of the mantle obliquely, which facilitates oxidation, and produces luminescence of peculiar brilliancy and of special tint. In order to obtain the highest result, the holes in the chimney should be cut obliquely, and should decrease in size according to the quantity of air necessary.

The burner shown in Fig. 2 is a No. 0, one-third the natural size,

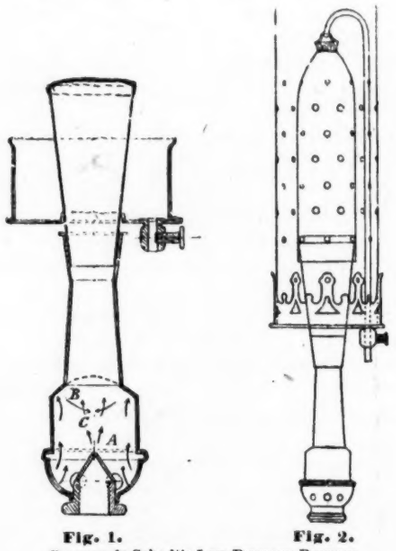


Fig. 1. **Fig. 2.**

Greyson de Schodt's Low Pressure Burners.

furnished with its chimney. In this model, incandescence is greatest at the lower part, where the air enters. According to experiments made in the Municipal Laboratory in Paris, these burners gave a light equal to 104 candles, with a consumption of 99 liters (3½ cubic feet) of gas. M. Richard, formerly Chemist to the City of Brussels, found that burners Nos. 1 and 3 gave, with consumptions of 125 and 220 liters (4.41 and 7.76 cubic feet) of gas, a light of 120 and 220 candles respectively at a pressure of 32 mm. These burners were furnished with chimneys having ordinary holes, and with mantles made by the well known method. These results, which are very satisfactory, are possible of improvement when the Plaissetty mantle becomes an article of commerce.

1. *Journal of Gas Lighting.*

The Witzenmann Metal Hose.

According to *Iron Age* the American Metal Hose Company, 40 Dearborn street, Chicago, are general sales agents for the United States of the Witzenmann metal hose or flexible metallic tubing. This hose is extensively used in Europe, and although but recently introduced in this country has met with favor. It is made entirely of metal, is more flexible than rubber hose of equal dimensions and is of about the same weight. When the product was first placed on the market many engineers thought it was impossible to make a steam tight hose entirely of metal which would have such flexibility. This quality has been secured by its peculiar construction. It is composed of a metallic tape which is rolled up in the form of a spiral, so that the edges overlap and fit into each other tightly without detracting from its power of motion. As the tape is rolled up it forms a groove for the reception of a packing, which is completely inclosed in the metal as it rolls, where it remains

fully protected from internal or external wear and tear. The packing causes the tubing to be perfectly tight, while the jointing induces a flexibility superior to rubber hose of equal dimensions.

The single hose is made in three styles. As shown in Fig. 1, the

Fig. 1.—Rubber Packing.

packing is of rubber and lies between the overlapping edges of the metal tape. This hose is made only for light work, such as the conveying of gas, and for discharge pipes on which the pressure is light. The single hose is also made packed with asbestos, the packing being held firmly in a groove of the tape, instead of simply lying between the overlapping edges. This tubing is designed for higher pressures and for other purposes for which the first would not be suitable. The double hose, shown in Fig. 2, is intended for steam. This hose is constructed

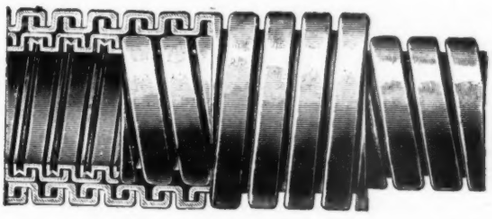


Fig. 2.—Double Hose for Steam.

of two tubes, one inserted within the other, and firmly fastened at the ends. The coils of these tubes are in opposite directions. While the coils of the single tubing may become intwisted from careless handling, or when subjected to great strain, this cannot happen with the double tubing. The double hose can be made in special cases to withstand a pressure up to 3,000 pounds per square inch.

Reconstructing and Modernizing Central Stations.

[A paper read by MR. O. M. RAU, at the last meeting of the Northwestern Electrical Association.]

The extraordinary rapid evolution made in electrical equipment has made it impossible to keep our stations abreast of the times, and the discouragement of the enterprising manager who attempts to keep his equipment "up-to-date," only to find that before his improvements are in practical operation, his plant is as much a back number as before, has been the rule rather than the exception, not only in the smaller installations, but also in the most important electrical construction recently completed.

With this condition there is some excuse for the obsolete apparatus in operation in the majority of smaller central stations throughout the country, the inefficiency of which makes the problem of the advisability of reconstruction one of simple mathematics.

The highest development has by no means yet been obtained in perfecting electrical generating apparatus and methods of distribution, but there are a number of definite conditions which can be acknowledged as sufficiently developed to leave little doubt of their permanency, and that future development will be in minor details which would not depreciate the apparatus in anything like the proportion the improvements of the past five years have. For this reason any of the old plants which have been holding on to their old equipment with the hope of making no mistake in changing to the best, should not hesitate to act, as the depreciation on old equipment is rapidly increasing, and the time is not far distant when an old type open arc or alternating current generator will be unsalable, and its value will not be more than so much scrap metal, no matter how good its condition may be. No better example of this rapid depreciation can be cited than the open multiple arc lamp, which is to-day entirely superseded by the inclosed arc lamp.

The steam equipments of these stations, as a rule, receive their share of attention, and modern devices to increase the efficiency are noticeable in many of the smaller plants, but when it comes to the electrical apparatus the condition is quite different. We often find a number of small old type alternators, an assortment of 25-light and perhaps a 50-light series arc generators, and occasionally a 500-volt power generator, all driven by a mass of belting, shafting, clutch pulleys, etc.

A proposition of this kind naturally causes some hard thinking before a conclusion as to what to keep and what to throw out can be arrived at. The plant must furnish power, incandescent and arc light for commercial purposes. and light the city streets, the latter preferably done by a separate circuit from that supplying commercial lighting.

A short time ago a large arc machine of 100 or 125 lights capacity, to displace a number of smaller ones, would have been recommended for the city service, while for the commercial service no two suggestions would have been the same, except to get large units and do away with shafting, all of which would, no doubt, have increased the efficiency of the plant sufficient to warrant the improvements, but they would not have simplified or economized the operation of the plant to any great extent.

The recent development of the alternating current has demonstrated that for the average central station (and I might go farther and include isolated plants) the flexibility of alternating currents leaves little to be desired, and for covering the unlimited demand that may come within the scope of a modern central station it is perfectly suited.

The efficiency of all apparatus in connection with alternating currents has reached a stage of perfection where no other class of service can equal it, and its application for commercial purposes is universal, with the exception of direct charging of storage batteries, which, at present, is not a defect to be seriously considered.

To-day the solution of our reconstruction problem is a simple one, and has none ot the questionable points to cause delay in obtaining its proper solution that confronted the manager formerly.

A single generator, covering all classes of service desired, takes the place of our former assortment, and either direct connected or direct belted solves the shafting problem. If this generator is obtained large enough so that the engine is the weaker part of the unit, in case of a heavy overload or short circuit, this excess of capacity is a valuable safeguard against its destruction.

Reconstructing a plant on these lines means abandoning all generators and installing one or two (preferably two) direct belted (in the latter case from separate engines) 3-phase alternating current generators of the 4-wire type, having 2,000 volts potential to the fourth or neutral wire.

This generator can be used for various classes of service from the separate phases, taking, for instance, the commercial incandescent and arc lights in the business district from phase No. 1 to neutral, installing at a convenient location close to the center of load a large transformer or bank of transformers, preferably placed in a manhole underground instead of attempting to hang the enormous weight of the larger transformers on poles where they are a continual source of anxiety and danger, as well as unsightly.

These transformers are to be connected to a secondary 3-wire distribution system, and if the plant was previously operated on the direct current 3-wire system, no better network could be desired to which to connect the transformer. The primary side of transformer would receive the current at approximately 2,000 volts through a feeder from phase No. 1 as before stated.

The outlying commercial business would be taken care of by phase No. 2, similarly to the present method of single phase distribution, by placing separate smaller transformers at such points as will serve the largest number of customers, or when distance becomes too great, a transformer for a customer. But in all cases the 3-wire secondary should be strictly adhered to, so that as the city expands and the business district grows, each secondary network may become part of the main secondary distribution system. All service should be 3-wire wherever practical, and care should be taken to keep those that are 2-wire alternately on each side of the system. This will maintain as near as practical a balanced load on the transformer.

From phase No. 3 the city arc circuits through constant current transformers can be served, and with the A. C. Series inclosed arc lamp the highest economy as well as the most satisfactory street lighting can be obtained. These transformers can be located in the main power house, or at transformer stations, centrally located in the lighting districts. In the latter case any shed, store or basement space could be utilized, as they require very little room. Or if desirable they could be placed in underground manholes similar to the transformers for the commercial circuits, although special attention must be paid to thorough ventilation and drainage, so as to prevent trouble from the high voltage of the circuits.

The trimmer of the route centering at these transformer stations

should be held responsible for this station and be required to start the lights by closing the circuit on these transformers at the proper time. This will insure reliable service and avoid any difficulties that are encountered if started from the main plant, from where they can readily be shut down by opening the primary circuit.

The expense of trimming and maintenance of the inclosed over the open arc system is very much reduced with the usual deduction for lights out with its disagreeable controversy with the city officials is practically eliminated.

For the power circuits a separate 3-phase feeder would be required from which power for motors would be taken, using a group of three transformers with a Y connection on the primary side and a delta connection on secondary side reducing the approximately 4,000-volt primary to 220-volt secondary. These transformers should be located so that the 3-phase secondary circuit would reach a number of power customers, as the installation of transformers for single customers becomes very expensive. By the use of 3-phase motors all trouble from excessive starting currents is overcome, and motors of any capacity within the range of the generating station can be successfully operated without any material effect on the incandescent circuits.

The most important feature of this method of distribution is the absolute control of each system, and the perfect regulation which can be obtained irrespective of the unbalanced condition of the load.

The series arc system being automatically taken care of by the constant current transformer, the 3-wire power circuit is not materially affected by variable loads, while on the commercial lighting circuits, regulating transformers giving a range of 10 per cent. above or below the generator potential can be placed in each feeder, and by means of a hand wheel constant potential can be maintained under all conditions of load.

In some instances a source of revenue is available at a considerable distance from the station. Perhaps a neighboring town, too small for an independent plant, a manufacturing plant, or some institution too far distant to be reached economically by the ordinary 1,000-volt system. In this case a feeder of two wires from one of the phases is used, giving a potential of approximately 4,000 volts, at which pressure the feed wire becomes a small factor and a considerable distance can be economically reached. By using two standard, 2,000-volt transformers with primaries in series and secondaries connected for standard voltage using the 3-wire secondary distribution system such business can be successfully taken care of.

In advocating the 3-wire secondary distribution system many points of advantage are obtained, the most important being the availability of 220-volt current at all services. Not only is the tendency to increase the voltage of incandescent lamps little by little, but the time is not far distant when a 220-volt lamp will be as efficient as those of lower voltage, and with the superseding of the multiple inclosed arc lamp by the Nernst lamp, the advisability of providing 220-volt secondary service cannot be questioned.

In preparing these few remarks my object was to point out a plan of reconstructing the many smaller central stations which are operating with old, inefficient apparatus, the value of which is so rapidly depreciating that most of it can only be appraised at scrap value, the owners of which have been delayed in taking action due to the rapid change made in electrical apparatus, and I hope my suggestions may help to decide this perplexing question.

The Development of the Indiana County (Pa.) Coal Fields.

[By Mr. Wm. Gilbert Irwin, in *Eng. and Mining Jour.*]

The total production of coal in Indiana county for 1900 was 924,782 tons, of which something like 90,000 tons were used in the production of coke and the remainder of the production went to the general bituminous coal trade.

For nearly 20 years the coke industry has been carried on in Indiana county, but it has only been within the past year or so that the rich fields of this county entered rightly upon their development. The figures of 1900 do not reflect the recent development of the coal industry in the county, nor does the gain for that year over 1899 give an adequate idea of the improvements now being made in the county. Most of the new mining properties have not yet been sufficiently developed to give an idea of what their production will be.

The physical position of Indiana county is such that its coal fields are divided into several geological divisions. The Upper Coal Measures, however, in most parts of the county are identical with the well-known Pittsburg bituminous vein. In the eastern part of the county, along the Indiana branch of the Pennsylvania Railroad, the leading coal vein is really an extension of the Connellsville coking seam, and some 10 or 15 years ago the coking industry was instituted in this part of the county on an extensive scale by J. W. Moore, the well known coke operator, who had sold his Westmoreland county coking properties to the H. C. Frick Coke Company. The coking business, however, was never a great success, and with the death of Mr. Moore the coking industry in the county suffered a decline from which it has never entirely recovered.

The Moore coking properties were established at Homer City and Blacklick, and a number of similar establishments along the Indiana branch are still operating, the coal being washed before it is charged into the ovens. This adds considerably to the cost of producing coke, and when there is a slack season in the coke trade the ovens usually close down. As the trade is now, however, the plants can be operated with a considerable profit, and the product, while not up to the standard of the Connellsville coke, proves a good furnace fuel. The coking operations have been confined to the valley of Blacklick Creek, a stream of considerable importance in the eastern part of the county. A number of mines for the shipment of raw coal have also been opened in this part of the county. When the present activities in the coal industry began, the first development in the county was experienced in this field. In it are included the townships of Blacklick, Center and White. The McCreary Coal and Coke Company has been operating in Center township for some time, and this Company took steps toward extending its coal territory. The Company has purchased about 3,000 acres of land. A number of other companies operating in this part of the county also bought up additional coal land, and Eastern capitalists have during the past year secured nearly 50,000 acres in this section.

The completion of the Buffalo, Rochester and Pittsburg Railroad through the county marked a new era in the industrial development of the field. The Rochester and Pittsburg Coal and Iron Company, the fuel branch of the road, immediately began buying up coal lands in the county. At first the coal purchases of this Company were confined to the northern part of the county, along the line of the road, and the purchases extended into Armstrong, Jefferson and adjoining counties.

Some months ago the Company began acquiring coal lands in White, Center and Blacklick townships, and up to date the land secured by the Company in the county aggregates about 25,000 acres, valued at something like $1,500,000, exclusive of the improvements already completed or now in progress. The Buffalo, Rochester and Pittsburg Railroad has already surveyed a number of coal lands in the county, and a large amount of money will be spent in opening up and equipping mines.

For some years a number of small coal companies have been operating along the Conemaugh and Kiskiminetas rivers, which bound the county on the south. Blairsville is now an important coal mining center and there are a number of mines along the West Penn division of the Pennsylvania Railroad. Transactions in coal lands in this part of the county have been active during the past year. In the east central part of the county in Pine Township a deal involving 35,000 acres and $3,000,000 capital was consummated during the past few months, the Philadelphia firm of J. H. Weaver & Company being the purchasers. The plans for the development of this property involve the construction of 12 big shaft mines and the erection of 3 mining towns. Another big coal tract is being developed for the manufacture of coke by the by-product coking process.

The business of leasing coal lands is still a leading one and there are still many thousand acres of land in the county under option and awaiting purchasers. The Pennsylvania Railroad is arranging for important extensions in the county, and with the railway developments now being made by the Buffalo, Rochester and Pittsburg road, which is pushing coal lines from the northern part of the county, the region will have ample shipping facilities. The Pennsylvania may also extend its coal roads from Cambria and Jefferson counties so as to tap the new fields in Indiana county. The new mines now being opened or planned will have the most modern equipment. This means electric haulage and tipple operation, electric mining machines and electric lighting; steel tipples, automatic trackage, and, in fact, all the modern appliances which enter into the most approved methods of bituminous coal mining, as practiced in the Western Pennsylvania fields. Everything will be done to increase the producing capacity of a mine, and nothing which tends to reduce coal mining to the most economic and scientific principles will be neglected.

Geological Pointers Respecting Petroleum Possibilities in Utah.

Dr. J. E. Talmage, geologist of the State University of Utah, has been receiving many inquiries as to the petroleum possibilities of that State. The properties of an oil boom, either actual or prospective, are such that the matter of fact man of science is frequently known to give local hope and enthusiasm the benefit of decided doubts with reference to petroleum prospects—to enter into the spirit of the boomers to a much greater degree than if he were passing geological opinion upon similar conditions in some other State. Dr. Talmage does not do this. While encouraging petroleum prospecting in Utah he does so in the manner of the cool headed geologist and not of the boomer. In a recent interview Dr. Talmage has spoken hopefully of Utah's oil possibilities and given an interesting resume as well touching the conditions under which petroleum has been formed and the formations in which it is found.

"I have at hand very little reliable information as to the assured occurrence of petroleum in quantity within our State," he said, "nor am I able to say how much of the popular rumor as to local oil discoveries is founded on fact and how much is but an emanation of the 'boom' spirit. But this is known—that Utah possesses vast accumulations of hydrocarbons of many different kinds, and that the existence of petroleum is geologically indicated. Petroleum, it should be remembered, is but one form of hydrocarbon minerals which are usually classed under the name of bitumen. This bitumen occurs in all gradations of physical state, from the attenuated natural gas, through the liquid but volatile naphtha to ordinary petroleum, thence on through the semi-liquid or tarry maltha to the solid asphaltum and allied minerals.

"Here," continued the professor, "is an extended series of samples showing petroleum and its principal products as gathered by myself from the oil wells and refineries of the East. The crude oil is a dark colored liquid with a greenish cast when viewed by reflected light, and a reddish color by transmitted rays. In the refining process the more volatile gasoline and benzine are first distilled off, then follow the several grades of kerosene with graded qualities as to inflammability, and a tarry residue which remains in the distilling apparatus. From this residue the different grades of paraffine oils and semi-solid mineral waxes are derived, and the final residuum is, as you see, a porous, coke-like substance consisting of fixed carbon.

"Now, all of the products thus derived from petroleum by artificial distillation are found in nature's laboratory; there are naphthas and heavier oils, mineral tars and waxes, and hard mineral hydrocarbons. It is a current belief that in nature these products result from the distillation of petroleum.

"You ask from what source and in what manner the petroleum itself is produced. Any reply to such a query is largely founded on theory. It was once held that petroleum is a product of coal distillation, hence the origin of the common name 'coal oil.' This conception arose from the marked similarity between the natural occurrences and the substances produced from coal by the chemist. It is objected to on the ground that there appears to be no necessary association of coal and 'coal oil' in nature, and that the rocks in which petroleum occurs are not such as bear evidence of intense heat action. The vegetable origin of coal is no longer a matter of serious question, and the organic origin of petroleum is quite as well assured. Geologists generally accept the theory that coal and its series of products resulted from the chemical change of vegetable matter under proper conditions of heat and pressure and in the presence of fresh water, while the petroleum products are due to chemical change of organic matter, both vegetable and animal, in the presence of salt water. This view respecting petroleum would explain the common association of oil and salt water. The organic matter from which the petroleum is produced is probably to be found in the fossiliferous rocks containing the bodies of animals and plants as accumulated in the seas of bygone days.

"As to the geological structure most favorable to the accumulation of oil, it may be said in general that oil resembles water in many particulars of its occurrence. Thus, the best subterranean reservoir for water consists of thick beds of porous rock, sand-stones, conglomerates and cavernous limestone, lying between layers of impervious rock, such as shale or compact clay, forming both floor and roof of the porous strata. If water enter the porous layer at a higher level, as will be the case if the strata are upturned in part of their course, the water will accumulate in the porous bed, and will reach the surface only when the impervious roof is broken through, as by a natural fissure or artificially, as by the driving of an artesian well.

"In an analogous way oil is found where other conditions are favorable, in porous rocks overlaid and underlaid by impervious layers which hold it imprisoned until punctured by the prospector's drill. There is this striking difference, however, between oil and water occurrences of the sort. The water reservoir is connected with a perennial supply, and the reservoir is not easily emptied, whereas the oil so stored is the result of slow accumulation during geological ages, and the reservoir is not replenished as fast as the oil wells drain it.

"I am aware of the old-time belief that the oil occurs in fissures and large caverns beneath the surface, but such an explanation is not applicable to petroleum occurrences in general. Fissures and caverns in porous rock otherwise suitable would constitute local reservoirs, and in the process of oil extraction fissures are artificially produced by 'shooting' the oil rock by means of explosives, thus increasing the facilities for percolation from the porous rock to the well bottom. Natural caverns and fissures of great size are rare occurrences, while porous rocks are common in all oil regions.

"As to the horizon, or geological age of the oil bearing rocks, a wide range has been proved, reaching from the very ancient silurian to the younger tertiary formations. Thus in Pennsylvania, Kentucky and Canada oil is obtained from devonian strata; in West Virginia and Ohio it comes from rocks of the carboniferous age; while cretaceous deposits yield oil in the Rocky mountain region, notably in Colorado and Wyoming, and tertiary formations in California, as also in the celebrated Baker region near the Caspian sea, and in Burmah. The Colorado, Wyoming and California oils are heavier than those of our Eastern fields; they yield less illuminating oil, but give a correspondingly greater portion of the more valuable lubricating oils.

"Practically no systematic field work in Utah and contiguous parts has been reported, touching the actual existence of oil in quantity, but from what little has been done, and from known facts concerning the existence of enormous deposits of allied hydrocarbon mixtures, I am reasonably confident as to the probable development of the oil industry here at home. The great Uintah basin south of the Uintah mountains and east of the Wahsatch, possesses all the outward promise of oil occurrences. The 'signs' so encouraging to the oil prospector are numerous and strong throughout this region, and the same may be said of many other old lake areas in the intermountain country."

The Fitting of Gas Stoves.[1]

Before coming to the real point of this article, viz., the best method of erecting and fitting a gas stove, it may be desirable to consider briefly one or two points connected with the use of gas stoves in general; because unless the precise object a customer has in view when he decides to adopt gas firing is thoroughly understood, the apparatus is liable to be selected injudiciously, or erected in such fashion that it will not give complete satisfaction. A gas stove may be required for one or two purposes—either to warm a sitting room which is occasionally or regularly inhahited, or a bedroom which is to be slept in, or perhaps lived in for weeks at a time by an invalid to whom purity of atmosphere, absence of noise, efficient ventilation, and uniformity of temperature by day and night are matters of life and death. There is nothing particular to be said for the moment about the fitting of a gas stove in a downstairs dwelling room or an upstairs breakfast room; but it must be remembered that in a bedroom (except in cases of illness) the stove is chiefly required during the evening, at a time when most gas is also needed to light the house, and that the piping must accordingly be arranged so as to interfere as little as possible with the lighting burners in the sitting room underneath. In case of illness—and it is always safer to assume that such will occur—the stove must be fixed in such a way as to permit or encourage a reasonable up current of stale air, over and above the products of combustion, through the chimney; since it frequently happens that the windows of an invalid's bedroom may not be opened during the whole period of the illness—or the winter. Another point of considerable importance, both in bedroom and dwelling room, is that the stove shall look cheerful when alight. Most people still regard gas firing as a convenient but inferior substitute for their well beloved coal fire, and this is a sentiment which we cannot afford to ignore. A coal fire has the property of looking cheerful and hot when it is very small and really emits very little heat. Now, most modern gas appliances look as cheerful as possible when they are working at, or nearly at, their full power; but there is considerable difference in different makes in what may be termed their "sentimental" effect when turned quite low. Owing to the dampness of an English winter, artificial warmth is often needed in rooms at a time when the temperature only requires to be raised 2° or 3°; and, therefore, the ideal stove is one which looks

1. *The Ironmonger*, London, Eng.

hot and lively even when it is not throwing out much heat. What is needed, then, to fulfil this requirement is a stove in which part of the incandescing material becomes actually hot to the eye when the consumption of gas is practically at a minimum.

Fixing a Gas Grate. From the present point of view gas warming appliances may be divided into two classes, the self-contained stoves sold by various makers and the arrangement of clay balls in the coal grate. We do not quite understand why so many people like these latter makeshifts, for they are undoubtedly wasteful and extravagant in comparison with any good stove. Sometimes in old houses where the grates are very convex in front, a stove put before the fireplace occupies more space than the user cares to afford; but modern registers have detachable bars and fronts which can be removed and the stove pushed back close against the fixed framework. Whenever possible this removal should always take place, as the stove looks neater when quite near the wall. The grate parts should be labelled with the name of the room whence they are taken, well greased and stored in a cellar. Neglecting ornamentation, the cost of a complete stove is not a serious item; and if the stove is often used its economy compared with coal will soon outweigh the first cost. A gas grate seldom looks as cheerful as a stove, even at full power, and when turned low it is very unsatisfactory in that respect. An undue proportion of its heat is apt to go up the chimney, while dirt and chips from the balls sometimes fall into the burners and interfere with their proper working.

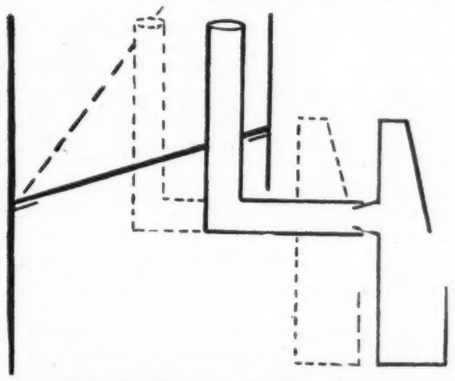
However, if the customer insists on having it, a gas grate must be fitted. The arrangement of leading tube and burners can be procured ready made; or a piece of ¾-inch barrel closed at both ends may be swept to a curve corresponding to that of the fire place, and drilled centrally underneath with a hole for the gas and air jet, and on top at regular intervals (carefully measured off to suit the apertures between the fire bars of the coal grate) with four or six holes for the upright burner tubes. These should have their tops cut on a bevel; and be pointed rather forwards, to keep dirt from falling into them as much as possible; while in convenient places two holes should be drilled and tapped to receive pieces of ¼-inch or ⅜-inch iron rod, the upper ends of which are also screwed and provided with two nuts each. This arrangement permits the main tube to be slung underneath the coal grate bottom, with the gas burners peeping up between the bars. In large rooms it is a distinct improvement to have two complete sets of burners and tubes supplied by different pipes and cocks, for in this way the power of the apparatus may be better adjusted to suit the weather. The balls need a considerabe amount of skill in their arrangement. The streams of gas must not be allowed to pass straight up through large apertures, nor must they be unduly restricted in their path; and towards the top, balls with smaller holes should be lodged among the rest of the material. Whenever the grate is large, a false back should he fitted inside to make the gas space shallower and to deflect as much of the heat horizontally as possible. A more cheerful effect may often be given by the judicious use of long fiber asbestos here and there in front and on top of the balls; since when the gas flames play on them the fibers glow and cool with the moving currents of air, and so imitate (somewhat imperfectly) the pretty flickering flames of the coal fire. Still, we can only consider these gas grates as inferior heating appliances, and personally we should prefer to empty a grate so fitted of the balls and use coke—especially in damp, underground sitting rooms, the gas being employed simply to ignite the coke. In such cases, however, a trustworthy and rather powerful flue is quite indispensable, while the adoption of coke at once destroys two of the advantages of gas firing—economy of labor and absence of dust.

Piping.—As regards the piping the best results will never be obtained, particularly in apartments with a much occupied room underneath, unless a special pipe is run right from the meter to the fire. The most obvious and cheapest way is to connect from the T of the central chandelier in the floor. This only means that when the upstairs stove is lighted the illumination below is defective. Certainly, when only incandescent burners are employed, the objection is less marked than formerly, but it still exists. A ½-inch pipe ought to be led from the meter to the stove, or, if there are several, a ¾-inch pipe from the meter, branching and diminishing as required, may be fitted to keep the warming "circuits" independent of the lights. If the customer wishes to indulge in that foolish habit of turning off his gas at the meter at night, care must be taken that a second main stop-cock is inserted inside the T leading to the stoves. In all cases it is desirable, and where there are invalids it is essential, to have a governor on the burner or the general house circuit. It is quite impossible to maintain a sick room at a regular temperature without constantly fingering the stove cock, if there is a cooking stove in the kitchen or a large number of stoves or mere lighting burners throughout the house. When the evening pressure is put on, and taken off, too, the stove is affected to such an extent that the cost of the governor is quickly made good to the consumer in avoidance of trouble, while it makes for economy all over the house by keeping the pressure at the point which best suits lighting burners and stoves. The usual practice for fitting stoves is to bring the pipe up through the floor at the right side of the hearth, and then to lead it directly to the stove. It is a most useful refinement to carry a copper pipe up the wall 3 feet or so high and then down again, putting the stop-cock at the top of the inverted ∩. An invalid or old person finds it very laborious to stoop to the floor to manipulate a cock. Similarly, it is well to ask the customer at which side of the fireplace the cock should be fixed, as, perhaps the left side may better suit the patient's chair. The cock itself must naturally be full way, and one with a quadrant and pointer saves much more trouble in adjusting the stove to suit the thermometer The union must invariably be on the stove side of the cock, as all stoves require periodical overhauling to remove dirt. In this connection, perhaps we may make a complaint about some types of gas fire. The burner tube is occasionally constructed in the shape of a narrow O, the interior of which is inaccessible. After some weeks' regular use in a bedroom with a good deal of dust, or after the stove has been turned too low and allowed to fire back to the jets, the tube becomes partially choked with material which causes the fire to burn irregularly; and it is a hopeless job to clean it. The O tube should be drilled, tapped and fitted with screw plugs at the two ends, so that a wire or mop can be run through it.

Dealing with the Flue.—There are two possible methods of dealing with the flue from a gas fire. It may simply be led into the chimney of the coal grate, leaving the surrounding space open, or that space may be closed by a sheet iron plate with a hole accurately fitting the flue pipe. If the space is left open a good deal of heat is wasted, because the warm body of the stove heats the surrounding air, and much of it passes up the chimney at once. If the space is closed, only the products of combustion and any air entering in front of the gas flames under the canopy of the stove itself escape up the chimney. Thus the closure is economical, while the open space is better for ventilation; and a fixed rule can scarcely be laid down as to the best course to pursue, since this must depend on the size of the room and the provision already made, if any, for proper ventilation. Assuming an invalid's room, if it is small, with well fitting windows and a floor covered with linoleum, etc., we should vote for the open register; for healthy people the closed register would be satisfactory and cheaper. In our own practice we have solved the difficulty by arranging the stove so that the space referred to can be opened or closed by merely pushing back or pulling forward the stove a few inches. The sheet iron plate is not cut centrally with a round hole to fit the stove flue, but at its front edge (when in position) it is slotted, U-fashion, to receive the round pipe. The stove elbow is jammed on very tightly, so that it cannot possibly work loose, and its upright part passes through the U-shaped slot. When the stove is pulled as far forward as it will go, the plate rests on the framework of the register in a way that practically shuts all the orifice except for the flue pipe; but if the stove is pushed back 2 or 3 inches (the spring of the copper gas supply pipe permits this) the vertical flue pipe causes the sheet iron plate to lift, its back edge behaving as a kind of hinge, until it stands almost upright, and the whole register opening serves to assist in ventilating the room.

Clearly the position of the stove is governed by the weather; on cold nights it is drawn forwards, in warm "muggy" weather it is pushed back. The accompanying sketch indicates the idea somewhat more plainly. The cast register door is, of course, fixed out of the way or entirely removed from the grate. Granting that the average householder will take the minute amount of trouble involved in this operation he will be surprised at the control it gives him over the temperature and "stuffiness" of the room. Naturally, we presume that the chimney is reliable. If the draught is not quite dependable, the closed register is necessary.

Roaring and "Firing Back."—Two troubles sometimes met with may be dismissed in a very few words. Roaring or excessive noise in either a gas fire or a gas grate is a sign of undue gas pressure. The cure is a governor. Firing back to the jets may be said never to occur with modern well designed gas fires, unless by carelessness they are turned down too low. This must happen now and again in ordinary households, and gives rise to the nuisance of deposited soot in the burner tube if the stove is permitted to burn for any length of time. It is very likely to happen in warm weather, if the stove is set for the night before the evening pressure is taken off, and in these circumstances it occurs when everybody is asleep. The cure here again is a governor.



The full lines represent the stove, flue pipe and register plate in their forward, cold weather, non-ventilating position; the dotted lines indicate the effect of pushing the stove back a few inches, which causes the register plate to lift and opens the chimney to the escape of stale air. The drawing is not to scale, but is a vertical fore-and aft section through the center of the stove, etc.

as the governed stove is not affected by the reduction of pressure in the mains. Firing back may take place persistently with badly made fires and with gas grates. If it does, too much air is being drawn in round the jets, and the air orifice most be made smaller. Perhaps wrapping a piece of copper gauze round the injector may stop the trouble.

We have said nothing about the erection of condensing stoves, because, although these devices are efficient as warming apparatus, they are only fit for halls and lobbies. A stove without a connection to a chimney must not be installed in any bedroom, sitting room, or kitchen. A condensing stove condenses the water produced by the combustion of the gas, but leaves all carbonic acid, etc., to escape, and the only place which is fit for the reception of carbonic acid is a flue with a steady draught. Stoves with luminous flames and reflectors are more satisfactory in appearance than the closed condensing stoves, but we cannot wax enthusiastic over their charms; and they, too, need the chimney, unless the gasfitter desires to be an involuntary party to a case of suicide. Wherever a gas stove is erected care must be taken that it is provided with an efficient supply of fresh air, and that in the absence of an inlet ventilator the stream of cold air which it sets up is not sucked into the room at a point where it is liable to produce a sensible draught when the fire is full on. It must never be forgotten that no chimney—not even a 250 foot factory shaft—can create an up current of air unless it has some opening at the base.

Wireless Telegraphy.

Engineering says that one of the puzzles connected with wireless telegraphy has been the great distance to which it has proved possible to signal. The radiation sent out from the transmitter is of the same nature as ordinary light, and subject to the same rules of refraction as the latter; but whilst the earth curves 8 inches per mile, the bending of a ray of light by the refraction of the atmosphere is only about 2 inches per mile, so that very high stations are needed for heliographing between points more than a few miles apart. Thus a ray of light emitted from a point 300 feet above sea level would touch the sea at a distance of about 25 miles; and hence two stations, 50 miles apart, could just heliograph to each other over the sea if each station was at a level of 300 feet.

In wireless telegraphy it has been found that enormously greater distances can be signalled over with comparatively low transmitting and receiving wires, although the Hertzian radiation used is less refrangible than ordinary light, being of incomparably greater wave length. This peculiarity of Hertzian telegraphy is touched upon in a highly interesting paper contributed to the *Revue Scientifique* by M. Poincaré, who attributes the success of the system principally to diffraction. Sound, as we all know, can bend round an obstacle; and the fact that he was unable to detect any similar bending in the case of light was urged by Newton as an objection to the wave theory of light, as originally proposed by Huyghens. More refined optical methods have shown that such bending does exist, but in the case of ordinary light it is extremely small. It increases, however, with the wave length, and by using waves sufficiently long the rate of bending may be greater than the curvature of the earth, and thus effective signalling may be established by means of these long waves between distant stations at comparatively low elevations.

It has further to be remarked, however, that the amount of energy set free in the form of Hertzian waves can easily be made much greater than can possibly be concentrated into a beam of light. The visible spark which passes between the knobs of a Marconi transmitter may give out as light, M. Poincaré considers, possibly as much as $\frac{1}{10^5}$ part of the energy expended in its production. If the eye were as sensitive as the Marconi receiver, the light of the spark should be visible for $\frac{1}{10}$ the distance over which wireless telegraphy can be effected; but experience shows that in this regard Art has beaten Nature, the coherer being immeasurably more sensitive than the eye. Further, whilst light is readily stopped by fog, this is not the case with the long undulations used in wireless telegraphy, fogs being as transparent to them as limpid water is to light.

There are two methods of increasing the distance over which Hertzian telegraphy is possible. The use of a long vertical wire is one, and this is best connected to the earth, as then the wave length is nearly doubled, which, as indicated above, is favorable to the covering of long distances. Moreover, the radiations given out are polarized, and the useful energy in the horizontal plane is, therefore, three times as great as if unpolarized radiations were used. The connection of the wire to earth has a further advantage, in that the spark between the transmitter knobs is "damped." There are thus but few oscillations between the knobs, but the energy of each is correspondingly increased, a fact which is favorable to long distance signaling.

In his recent work, however, Mr. Marconi has abandoned the use of the long vertical wire for the transmitter, and has got his best results with a substitute, which at first sight would seem ill adapted for the purpose. This he has effected by making use of the principle of resonance. With the straight vertical wire connected to the transmitter as used in the earlier instruments, the radiation produced was made up of waves of every length. In the new Marconi exciter the object aimed at has been to produce a series of waves of one uniform wave length. Hence, to use an acoustical analogy, the radiation from the early type of exciter corresponded to a "noise," whilst in the later type it is equivalent to a musical note. Now, it is well known that a pianoforte wire, for example, will respond to a very feeble disturbance if this be of the right pitch and sufficiently prolonged. Each vibration, though feeble in itself, affects the string at just the right moment to increase the effect of the previous one, so that finally the string may be put in quite powerful vibration. In a similar way Mr. Marconi's receiver is tuned to synchronize exactly with the waves radiated by the transmitter. These waves may be each much less powerful than those generated by the earlier form of his instrument, but there are many more of them, and each increases the effect of its predecessor. Hence with the new type of transmitter the distance covered is greater than with the earlier type, though this increase is only observed if the receiver is in perfect tune with the transmitter, and one not so in tune will only respond at a distance much less than it would do with the original arrangement.

ITEMS OF INTEREST FROM VARIOUS LOCALITIES.

SENATOR BRACKETT is responsible for the presentation of a bill in the New York Legislature which declares that "no person or persons, partnership or corporation in the city of Schnectady shall, after July 1st, 1902, ask, demand or receive for illuminating gas a sum to exceed $1 per 1,000 cubic feet, and such gas shall have the illuminating power of not less than 22 sperm candles, of 6 to the pound, burning at the rate of 120 grains of spermaceti per hour," etc. The second section of the Brackett impossibility prescribes that those "violating" the bill shall, upon being adjudged guilty, be punished by a fine of not less than $200, or by imprisonment in the county jail for a period of not less than 30 days, or by both such fine and imprisonment. The measure must be of a "waggy" nature; for certainly no man clad or clothed in his right mind could expect the sanction of his fellows in such plan.

THE authorities of Fostoria, O., are seriously considering the taking over, for operation on public account, of the local gas plant.

IT is reported that Governor Voorhis has annulled the charter of the South Amboy (N. J.) Gas Light Company for its failure to make payment of taxes on State account.

THE Common Council of Cohoes, N. Y., recently passed an ordinance granting to Messrs. Michael Powers and Edward McCreary (who, of course, are dummies) a franchise to manufacture and distribute gas and electricity in that city. Under the terms of the grant it is agreed that gas shall be supplied on city account, and for any purpose, at the rate

of 50 cents per 1,000 cubic feet, and that the charge on general account shall not exceed $1 per 1,000. The grantees have until January 1, 1905, to construct the works. The thing is a "strike," pure and simple.

MR. JOHN COLLINS, formerly in charge of the works of the Port Jervis (N. Y.) Company, has been appointed Superintendent of the Newton (N. J.) Gas and Electric Company.

MR. ALONZO J. RAND, formerly Vice-President of the Minneapolis (Minn.) Gas Light Company, has been elected President of the Company, vice the late Mr. Harvey W. Brown. Mr. R. R. Rand was elected Vice-President.

MAJOR T. ATTWATER BARNES, for several years prominent in the direction of the affairs of the New Haven (Conn.) Gas Light Company, died at the Hotel Van Nuys, Los Angeles, Cal., the morning of the 27th ult. The cause of his death was apoplexy, and a particularly sad feature of the case is that Major Barnes had journeyed to California to be present at the wedding of his son Amos, which was to have taken place in Monterey, Cal., last Monday. Deceased was born in New Haven, January 13, 1848, and he was connected in a positive manner with many of the most important business institutions of his native city.

MR. JOHN N. MILLS has resigned from the service of the Cedar Rapids (Ia.) Gas Company.

MR. CHARLES F. SMITH has retired from the superintendency of the Lebanon (Pa.) Gas Company, the cause of his giving up active work being impaired health. His successor is Mr. J. N. Merritt, of Springfield, Mass.

THE City Council, of Quincy, Mass., has passed an order rescinding the action of the Council of 1901, which directed that proceedings be taken before the Board of Gas and Electric Light Commissioners to compel the Citizens Gas Light Company, of Quincy, to reduce its selling rates.

THE proprietors of the Burlington (N. J.) Gas Light Company recently brought suit against the Burlington Sewage Company for damages arising from the negligence of the workmen of the defendant. It was shown on the trial that through the carelessness of the Sewage Company's men a main pipe of complainant was fractured, and that the fracture resulted in the loss of 30,000 cubic feet of gas. The jury found for complainant, and assessed the damages at $82.80.

MR. GUSTAV C. SOLDEN, who may be remembered from his active connection with the construction of the plant of the Chesapeake Gas Company, of Baltimore, Md., died, at his home in Baltimore, the last week in January. Mr. Solden was born in Gissen, Germany, Feb. 15th, 1839, and was the son of Dr. William Solden, President of the University of Gissen. He came to America in 1866, and later on took service as head of the mechanical department of the famous Edison workshops at Menlo Park, N. J., in 1877. Having completed the Chesapeake gas works he went to Chicago, where he superintended the construction of the power plants of several large factories, in which particular line he was undoubtedly a successful expert. He is survived by his widow, a son and three daughters.

AT the annual meeting of the Springfield (Mass.) Gas Light Company the shareholders had good reason for being pleased with the work that had been accomplished during the twelvemonth, as such was revealed by the reports of the officers. The officers elected were: Directors, C. H. Tenney, F. P. Royce, H. P. Wood, W. F. Callender, C. L. Goodhue, F. de V. Thompson, H. C. Warren, Samuel A. York and H. W. Whipple—Mr. York succeeds Mr. David Allen Reed; President, Charles H. Tenney; Vice-President, F. P. Royce; General Manager, F. de V. Thompson, Treasurer, Eugene Milliken.

THE sale of the franchise and plant of the Huntsville (Ala.) Gas Light Company, which was to have been brought off at Huntsville last Monday, has been postponed to March 13th. Mr. Oscar R. Hundley, the Receiver in charge of the properties, can be applied to during the intervening time for any needed information. His address is Huntsville, Ala.

MR. FROTHINGHAM, of Boston, has introduced into the House of the Massachusetts Legislature a petition, framed by a Mr. Burnett, asking "for such legislation as may be necessary to enable gas companies, and all persons manufacturing or selling gas in Boston or vicinity, to unite and consolidate; such consolidation to be effected throughout by the formation of one or more gas companies, with authority to purchase any or all stocks or properties of such gas companies or persons, or to be effected in such other manner as the General Court may deem just." The Boston *Transcript*, in commentiug on the scheme, says the bill accompanying the petition is that recommended by the Board of Gas and Electric Light Commissioners in 1899, save that the present one provides for consolidation into "one or more" companies instead of one.

THE Directors of the Greenfield (Mass.) Gas Light Company have declared a semi-annual dividend of 3 per cent., payable on demand.

MR. T. N. HOLLIDAY has been appointed Superintendent of the Detroit Suburban Gas Company, the proprietors of which propose to construct a plant for the supply of gas to the residents of Delray and other suburbs of Detroit.

WE are indebted to the courtesy of Mr. H. Reeve Dayton, Manager of the Welsbach Gas Lamp Company, 1131 and 1133 Broadway, N. Y., for a specimen of the Welsbach Company's calendar for the current year. It is a beauty; and we thank him for it.

THE mains of the Port Jervis (N. Y.) Company are to be extended to and through the suburb of Germantown.

MR. HULETT C. MERRITT has been elected President of the United Electric, Gas and Power Company, of Santa Barbara, Cal.

AS heretofore noted in the JOURNAL, Palo Alto, Cal., is to have a gas works. The corporate name of the concern is the Peninsular Gas Company, and it is capitalized in $200,000. The Directors are: John M. Gardner, R. P. C. Smith and James D. Schuyler, of Los Angeles; O. Z. Hubbell, of Ontario; M. N. Sheldon, of San Francisco; and W. M. Sheldon, of Palo Alto.

IT looks that the competing interests for the right to construct a gas works in Charleston, Ills., have arrived at an understanding, and that the plant will be placed this spring. The concern is to be known as the Charleston Gas Company, and its officers are: President, C. H. Dummer, of Chicago; Vice-President, J. W. Ramsey; Secretary and Treasurer, Arthur H. Bayston, also of Chicago.

THE proprietors of the Ann Arbor (Mich.) Gas Company have authorized the Western Gas Construction Company to erect for them a complete exhausting, tar extracting, condensing, washing, scrubbing and purifying plant. The scrubber is to be of the Holmes rotary type, and the boxes are to be of the Western duplex system, of a depth dimension of 11 feet 6 inches.

THE Lowell (Mass.) Gas Light Company has decided to make application to the Board of Gas and Electric Light Commissioners for the right to make an important addition to its capital stock.

MR. CHAS. L. SCHANERBERGER, a trusted employee of the Allentown (Pa.) Gas Company, died the morning of the 25th ult. He was in his 33d year.

A RECENT issue of the San Francisco *Examiner* contained the following, which would seem to show that selling rates for gas and electric currents in that city will shortly be put upon an equal, if not an equitable basis: "A petition largely signed will shortly be presented to the Supervisors asking them to establish uniform rates for consumers of gas and electric current, forbidding discrimination and making the lowest price charged in any part of the city applicable to all other parts. The petitioners call attention to the fact that gas and electric current has been for more than 6 months sold at rates ranging from 50 cents to $1.40 per 1,000 cubic feet for gas and 3½ cents to 11 cents per 1,000 watt hours for electric current, the prices depending upon the condition of competition existing or threatened in various parts of the city. It is held that the rates should be uniform, and it is no excuse for a difference that in certain localities there is competition. The purpose of making the low rate, it is claimed, is to crush out competition. The petitioners assert that the discrimination can be prevented by the Supervisors adopting a uniform rate and prohibiting discrimination."

(*Continued on page* 197.)

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MONDAY, FEBRUARY 10, 1902.

(*Concluded from page* 196.)

Engineering News announces that a competitive examination of draftsmen will be held at the League Island Navy Yard to fill the following positions: One first-class structural steel work draftsman, at $5.04 per diem, and two first-class architectural draftsmen, at $5.04 per diem. The examination will be open to all comers who can give evidence of experience in the kind of work for which they seek employment, and who are citizens of the United States. The examination will be practical in character, having reference exclusively to the requirements of the positions to be filled; the applicant's antecedents and experience as well as the character of his previous work, will be duly considered. The structural steel work draftsman shall be competent to detail structural steel work, and to make such computations of stresses in frame structures as required in steel building construction. Applicants for first-class architectural draftsmen will be required to show past experience, together with ability to design and develop architectural details from sketches. Applications should state name, age, residence, citizenship, present occupation and previous employment or work done; they should be addressed to the "Commandant, Navy Yard, League Island, Pa.," and must be delivered to him on or before Monday, Feb. 17, 1902. A board of examiners will convene at the Navy Yard, League Island, Pa., on Feb. 18, or as soon thereafter as practicable. Applicants will be informed of the date upon which they will be required to report for examination.

The Market for Gas Securities.

There was some trading done in Consolidated last week, all of which was completed at average higher prices than those that prevailed for some weeks. Towards the close of business today (Friday) a reaction, or rather selling for profit taking account, was chronicled, the ending figures being 217⅛ to 218½. The recent protracted cold spell, accompanied by some "days that were dark and dreary," served to put the manufacturing ends of the huge concern on their mettle. The demand for all classes of city gas bonds rather increases than diminishes.

Sales of Brooklyn Union were also reported, with the result that the bid price was marked up to 216, the asking figure being 217; but we venture the prediction that a positive buying order for 1,000 shares "for cash" would send the price to 230. The Company has declared its regular quarterly dividend of 2 per cent., payable the 1st prox. Legislation is being sought from the Massachusetts lawmakers whereby the conflicting gas interests in and around Boston may be put together in harmony. Let us hope that the threads of the maze are about to be disentangled. Washington (D. C.) gas made a new high record for itself last week. Holders ask 375 for it; in 6 months' time they will want and get 400. Peoples, of Chicago is on the mend, and Consolidated, of Baltimore more than holds its own.

Bay State is absolutely unheard of, and Lacledes are in better demand. If investors "on the outside" are in doubt as to the growth of the gas industry they will have such doubt dispelled through the simple asking of any reputable constructing or supply firm how the order books stand.

Gas Stocks.

Quotations by George W. Close, Broker and Dealer in Gas Stocks.

16 WALL STREET, NEW YORK CITY.

FEBRUARY 10.

☞ All communications will receive particular attention.
☞ The following quotations are based on the par value of $100 per share.

N. Y. City Companies.	*Capital.*	*Par.*	*Bid.*	*Asked.*
Consolidated	$73,177,000	100	217⅛	218⅛
Central Union, Bonds, 5's.	3,000,000	1,000	109½	111
Equitable Bonds, 6's	1,000,000	1,000	105	
" 1st Con. 5's	2,300,000	1,000	115	118
Metropolitan Bonds	658,000	..	108	112
Mutual	3,500,000	100	310	315
" Bonds	1,500,000	1,000	100	102
Municipal Bonds	750,000	.	..	
New Amsterdam Gas Co. .. Bonds, 5's	11,000,000	1,000	109½	109¾
Northern Union, Bonds, 5's.	1,250,000	1,000	106	108
New York and East River .. Bonds 1st 5's	3,500,000	1,000	111	115
" 1st Con. 5's	1,500,000	..	109	111
Richmond Co., S. I.	348,650	50	100	..
" Bonds	100,000	1,000	103	
Standard	5,000,000	100	130	135
Preferred	5,000,000	100	150	155
Bonds, 1st Mortgage, 5's	1,500,000	1,000	118	..
Yonkers	299,650	500	130	
Out-of-Town Companies.				
Brooklyn Union	15,000,000	100	216	217
" " Bonds (5's)	15 000,000	1,000	119	119½
Bay State	50,000,000	50	⅝	¾
" Income Bonds	2,000,000	1,000	.	75
Binghamton Gas Works	450,000	100	28	30
" 1st Mtg. 5's	509,000	1,000	93	96
Boston United Gas Co.— 1st Series S. F. Trust	7,000,000	1,000	82	85
2d " " "	3,000,000	1,000	47½	50
Buffalo City Gas Co.	5,500,000	100	8½	10
" " Bonds, 5's	5,250,000	1,000	79	80¼
Capital, Sacramento	500,000	50	..	35
Bonds (6's)	150,000	1,000	..	..
Central San Francisco	2,000,000	..	106	108
Chicago Gas Co. Guaranteed Gold Bonds	7.650.000	1,000	104	104¼
Cincinnati Gas & Elec. Co.	29,500,000	100	101¼	101⅛
Columbus (O.) Gas Co., 1st Mortgage Bonds	1,500,000	1,000	106	107
Columbus (O.) Gas Lt. & Heating Co	1,682,750	100	60	65
Preferred	3,026,500	100	84	86
Consumers, Jersey City Bonds	600,000	1,000	102	103
Consumers, Toronto	1,700,000	50	218	225
Consolidated, Baltimore	11,000,000	100	63¾	64
Mortgage, 6's	3,600,000	..	..	118
Chesapeake, 1st 6's.	1,000,000	..	..	..
Equitable, 1st 6's.	910,000	..	..	..
Consolidated, 1st 5's	1,490 000		.	112
Consolidated Gas Co. of N.J.	1,000,000	100	12	14
" Con. Mtg. 5's	380,000	1,000	79	83
Consolidated G. & E. Co.'s., Little Falls, N.Y.	90,000	100	..	100
Bonds	75,000	..	..	100
Detroit City Gas Co	4,825,500	50		89
" Prior Lien 5's	5,603,000	1,000	99¼	100
Detroit Gas Co., 5's	381,000	1,000	89	89½
" Inc. 5's	16,000	100	94	94½
Equitable Gas & Fuel Co., Chicago, Bonds	2,000,000	1,000	..	101
Essex and Hudson Gas Co.	6,500,000	..	34	38
Fort Wayne	2,000,000	..	..	.
" Bonds	2,000,000	..	53	55
Grand Rapids Gas Lt. Co. 1st Mtg. 5's	1,225,000	1,000	102	104
Hartford	750,000	25	245	265
Hudson County Gas Co., of New Jersey	10,500,000	..	25	..
" Bonds, 5's	10,500,000	..	101	103
Indianapolis	2,000,000	..	60	64
" Bonds, 6's	2 650,000	..	99½	101½
Jackson Gas Co	250,000	50	68	71
" 1st Mtg. 5's	290,000	1,000	101	102½
Kansas City Gas Light Co., of Missouri	5,000,000	100	..	36
Bonds, 1st 5's	3,822,000	1,000	102	104
Laclede, St. Louis	10,000,000	100	91	92
Preferred	2,500,000	100	105	110
Bonds	10,000,000	1,000	..	108½
Lafayette Gas Co., Ind.	1,000,000	100		60
Bonds	1,000,000	1,000	48	55
Louisville	2,570,000	50	110	120
Madison Gas & Elec. Co. " 1st Mtg. 6's	350,000	1,000	107½	109½
" 6 per cent. scrip, due 1910	100,000	25	25	87
Montreal, Canada	2,000,000	100	182	184¾
Newark, N. J., Con. Gas Co	6,000,000	..	..	55
Bonds, 6's	4,600,000	.	..	103
New Haven	1,000,000	25	300	325
Nashville Gas Lt. Co.	1,000,000	100	110	..
Oakland, Cal.	2,000,000	..	46	47
" Bonds	750,000	..	..	..
Peoples G. L. & Coke Co., of Chicago	25,000,000	100	101	101¼
Peoples Gas Lt. & Coke Co., Chicago, 1st Mortgage	20,100,000	1,000	..	..
2d "	2,500,000	1,000	104	
Rochester Gas & Elec. Co.	2,150,000	50	88	..
Preferred	2,150,000	50	118	..
Consolidated 5's	2,000,000		87½	90
San Francisco, Cal.	10,000,000	100	44	44¾
St. Paul Gas Light Co.	1,500,000	100	60	68
1st Mortgage 6's.	650,000	1,000	113	116
Extension, 6's.	600,000	1,000	112½	115
General Mortgage, 5's.	2,465,000	1,000	93	96
St. Joseph Gas Co. " 1st Mtg. 5's	751,000	1,000	98	96
Syracuse, N. Y.	1,750,000	100	14	16
Bonds	1,612,000	1,000	92	94
Washington, D. C	2,600,000	20	362½	375
First mortgage 6's	600,000	..	.	..
Western, Milwaukee. Bonds, 5's	4,000,000	..	106½	108
Wilmington, Del	600.000	50	232	..

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DIVIDEND NOTICE.

OFFICE AMERICAN LIGHT AND TRACTION CO., JERSEY CITY, N. J., January 21, 1902.

The Board of Directors has this day declared a quarterly dividend of 1¼ per cent., for the quarter ended December 31, 1901, on the preferred stock of the Company, payable February 15, 1902, to preferred stockholders of record at the close of business on January 31, 1902, at which time the transfer books of the preferred stock will close, and will remain closed until February 17, 1902. Checks will be mailed.

1391-2 EMERSON McMILLIN, President.

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A Position as Manager or Superintendent of a Coal Gas Company,

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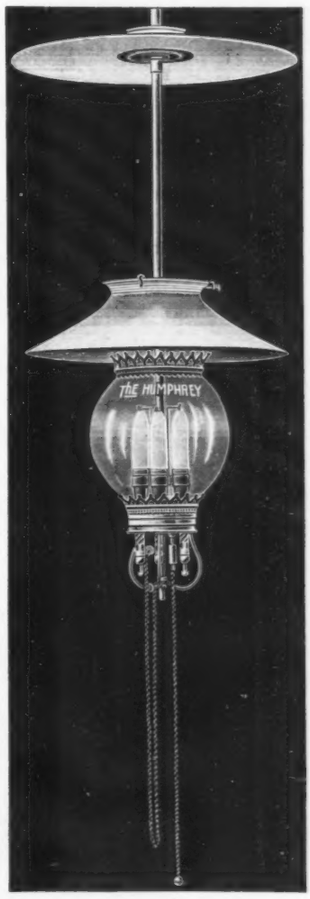

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The Pioneer Vertical Water Tube Boiler of the World.

High quality and durability of the Tubes, the Most Vital Part of a Boiler.

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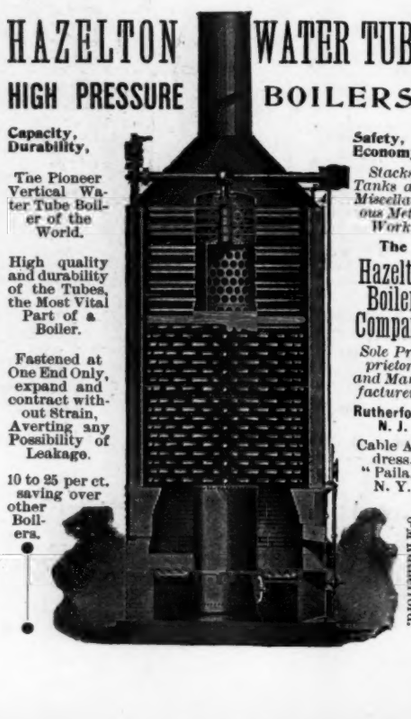

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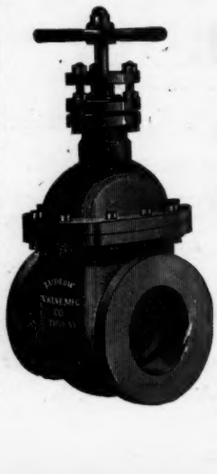

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A BRILLIANT SUCCESS.

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To burn a given amount at a stated pressure, made to order. Samples furnished. Also, small oil and air valves, slow-feed valves for high pressure, and small brasswork in general.

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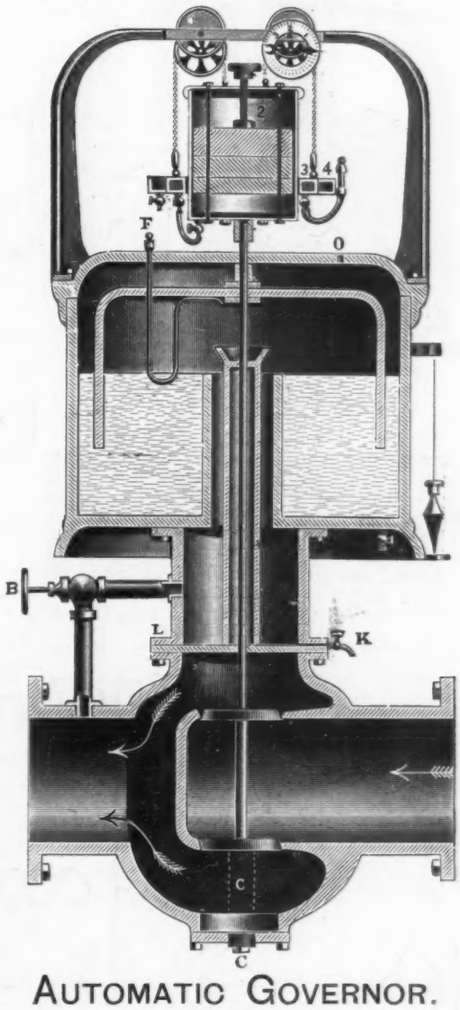

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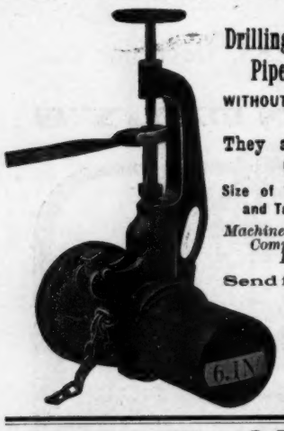

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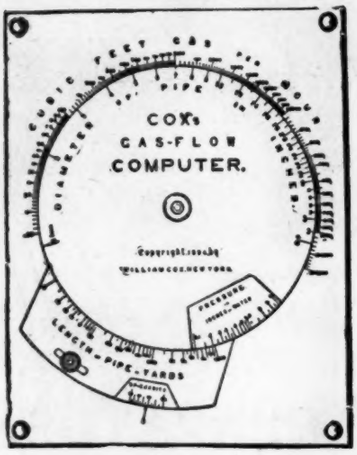

Do you wish to Know

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as it gives this information accurately at sight, without mental effort. No calculations needed. Saves time, money and mistakes.

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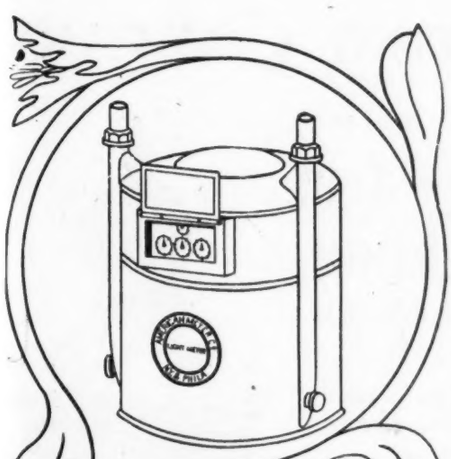

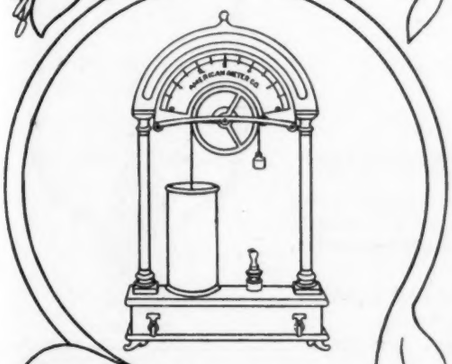

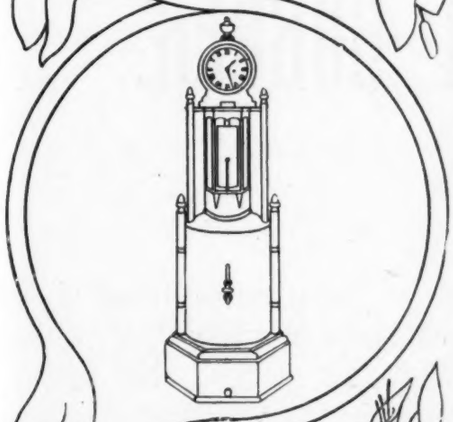

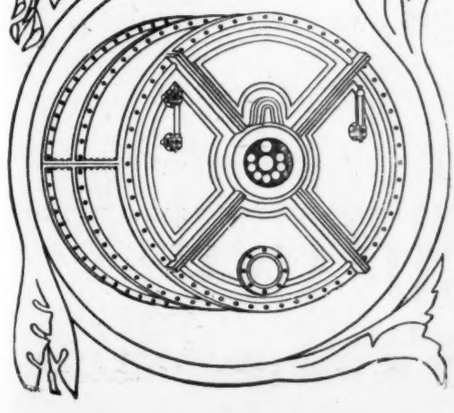

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NEW YORK AND PHILADELPHIA,

CHICAGO, ST. LOUIS,

SAN FRANCISCO.

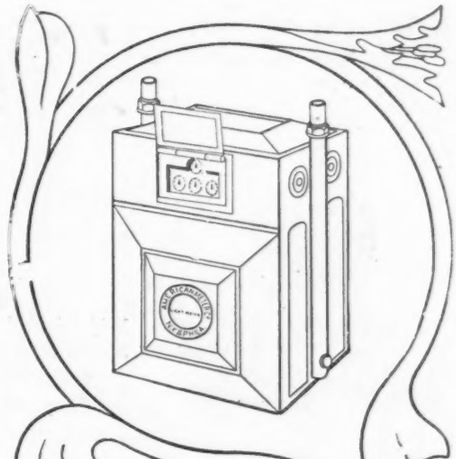
PUBLIC LIGHTING TABLE.

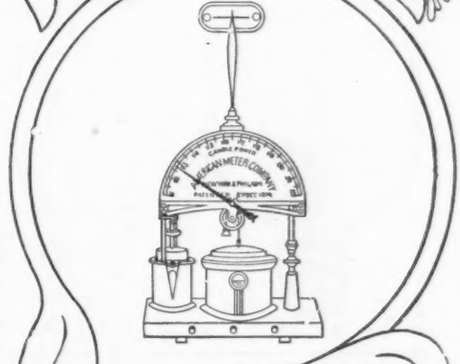
FEBRUARY, 1902.

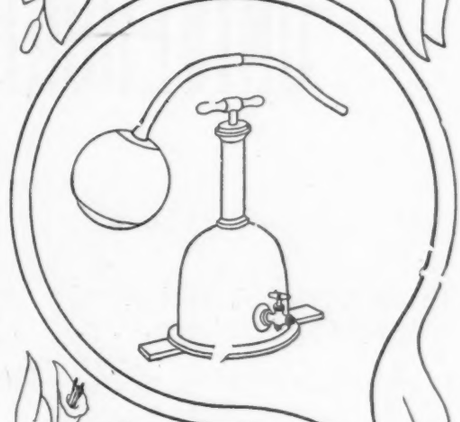
Day of Week.	Table No. 1. Following the Moon. Date.	Light.	Extinguish.	Table No. 2. New York City. All Night Lighting. Light.	Extinguish.
				P.M.	A.M.
Sat.	1	5.40 PM	3.20 AM	5.05	6.15
Sun.	2	5.50	4.10	5.05	6.15
Mon.	3	5.50	5.00	5.05	6.15
Tue.	4	5.50	5.40	5.05	6.15
Wed.	5	5.50	6.10	5.10	6.10
Thu.	6	5.50	6.10	5.10	6.10
Fri.	7	5.50	6.10	5.10	6.10
Sat.	8	5.50 NM	6.10	5.10	6.10
Sun.	9	6.00	6.00	5.10	6.10
Mon.	10	6.00	6.00	5.10	6.10
Tue.	11	6.00	6.00	5.10	6.10
Wed.	12	6.00	6.00	5.20	5.55
Thu.	13	10.30	6.00	5.20	5.55
Fri.	14	11.40	6.00	5.20	5.55
Sat.	15	12.40 AM FM	6.00	5.20	5.55
Sun.	16	1.40	5.50	5.20	5.55
Mon.	17	2.40	5.50	5.20	5.55
Tue.	18	3.30	5.50	5.20	5.55
Wed.	19	4.10	5.50	5.30	5.55
Thu.	20	4.50	5.50	5.30	5.55
Fri.	21	No L.	No L.	5.30	5.55
Sat.	22	No L. FM	No L.	5.30	5.55
Sun.	23	No L.	No L.	5.30	5.55
Mon.	24	6.20 PM	9.20 PM	5.30	5.55
Tue.	25	6.20	10.20	5.30	5.55
Wed.	26	6.20	11.10	5.30	5.45
Thu.	27	6.20	12.10 AM	5.30	5.45
Fri.	28	6.20	1.10	5.30	5.45

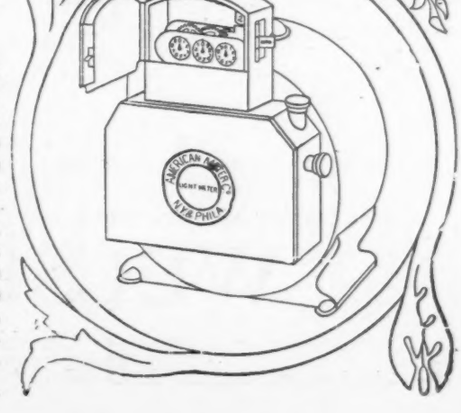
TOTAL HOURS LIGHTING DURING 1902.

By Table No. 1.	Hrs. Min.	By Table No. 2.	Hrs. Min.
January	238.30	January	423.20
February	196.20	February	355.25
March	196.20	March	355.35
April	166.40	April	298.50
May	151.40	May	264.50
June	131.10	June	234.25
July	142.40	July	243.45
August	162.00	August	280.25
September	179.00	September	321.15
October	216.30	October	374.30
November	224.10	November	401.40
December	250.00	December	433.45
Total, yr.	2255.00	Total, yr.	3987.45





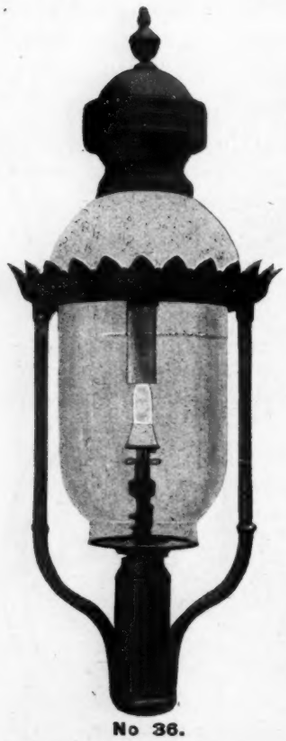




NEW YORK, 33 Nassau Street. PHILADELPHIA, Broad and Arch Streets. CHICAGO, Foot of Orleans Street. BOSTON, 624 Tremont Building.
CLEVELAND, 809 Cuyahoga Building. ST. LOUIS, 712 Roe Building. SAN FRANCISCO, 712 Polk Street.

WELSBACH STREET LIGHTING COMPANY

.... OF AMERICA ....



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Which includes its specially DESIGNED AND PATENTED BURNER for STREET and PARK LIGHTING exclusively.

Uniformly SUCCESSFUL in 150 Cities and Towns.

By means of the Welsbach System of street lighting the superiority of GAS over electricity for street lighting has been fully demonstrated.

POINTS OF MERIT:

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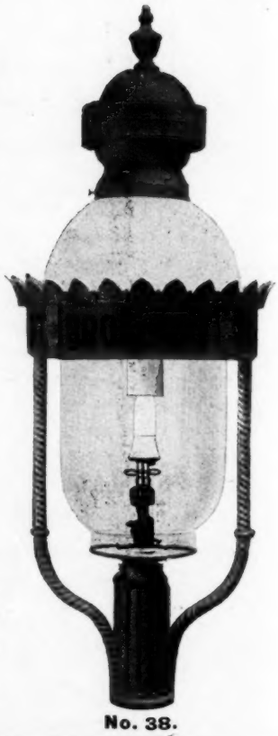
IT LIGHTS THE STREET.

Where there are no gas mains we can furnish an equally good light by our SELF-GENERATING NAPHTHA WELSBACH BURNER, and thereby supply a uniform light in all localities.

Correspondence Solicited from Gas Companies and Others Interested in Municipal and Outside Lighting.



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The most practical, efficient and artistic burner yet produced. . . . . .

It contains an improved adjustable Bunsen so constructed as to permit of a wide range of variations in gas pressure without blackening the mantles and without an adjustable air shutter. . .

It can be used with all styles and sizes of glassware, either shades or globes. No further necessity to carry a stock of different burners for the many sizes and shapes of glassware.

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The capacity of apparatus installed, if operated continuously, is sufficient to make more than the entire amount of artificial gas annually sold in the United States.

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Modern Recuperative Furnaces.

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GEROULD'S IMPROVED RETORT CEMENT

A Cement of great value for patching retorts, putting on mouthpieces, making up all bench-work joints, lining blast furnaces and cupolas. This cement is mixed ready for use. Economic and thorough in its work. Fully warranted to stick.

Price List, f.o.b. Galesburg, Ills., or Buffalo, N. Y.
In Casks, 400 to 800 pounds, at 5 cents per pound.
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Half and Full Depth Benches of Our Own Design,

Containing 6, 8 or 9 Retorts.

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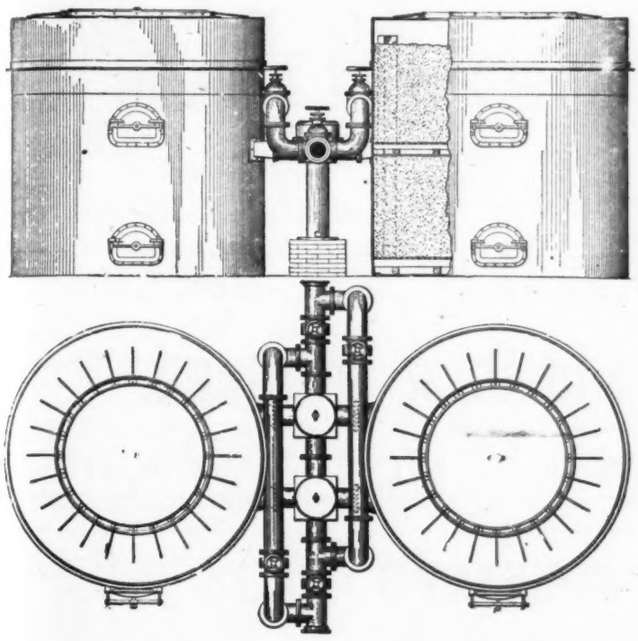

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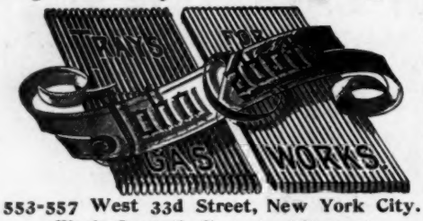

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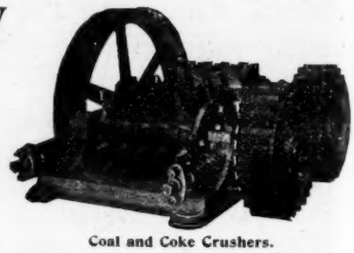
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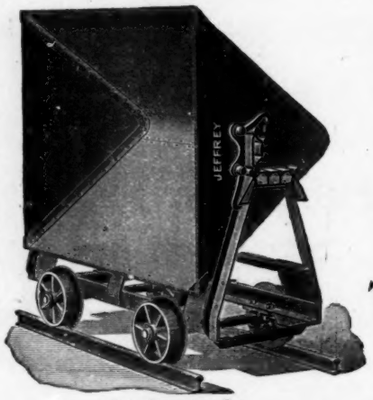

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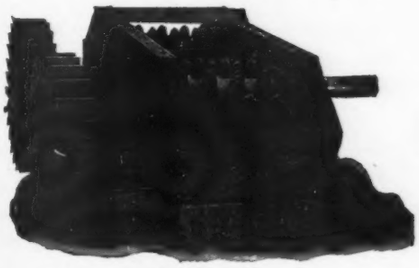

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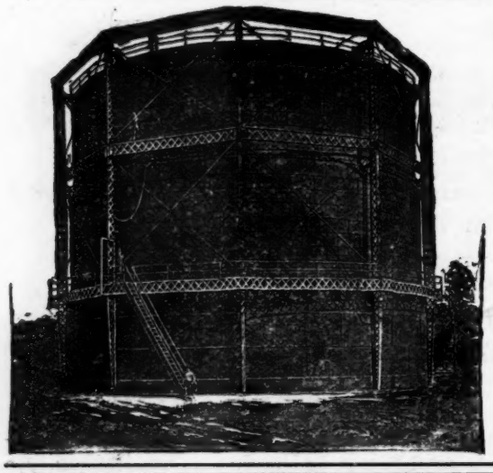

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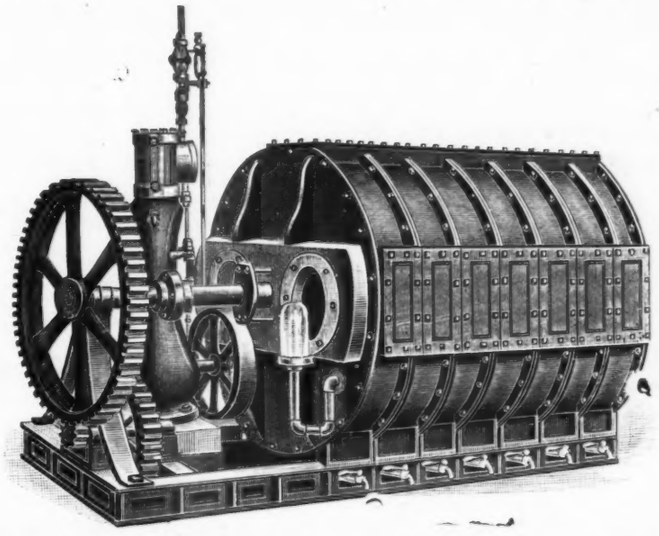

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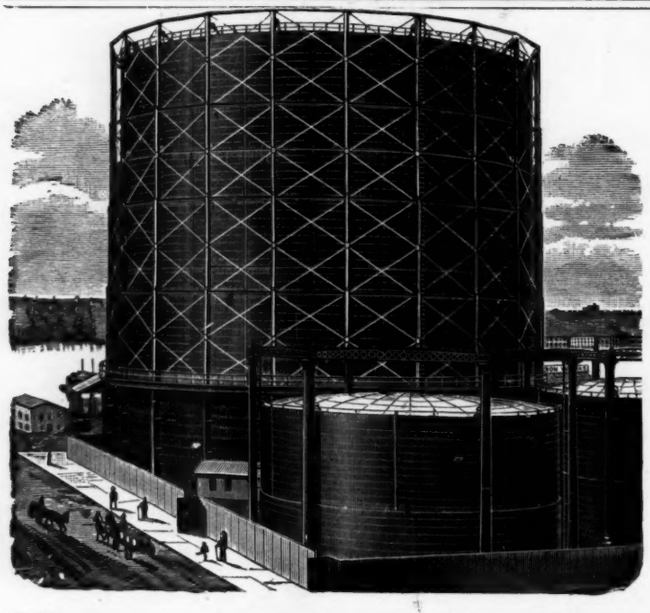

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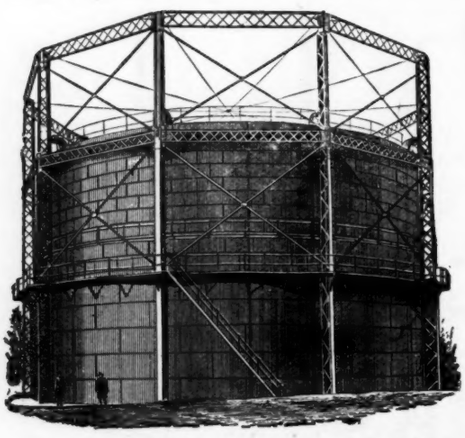

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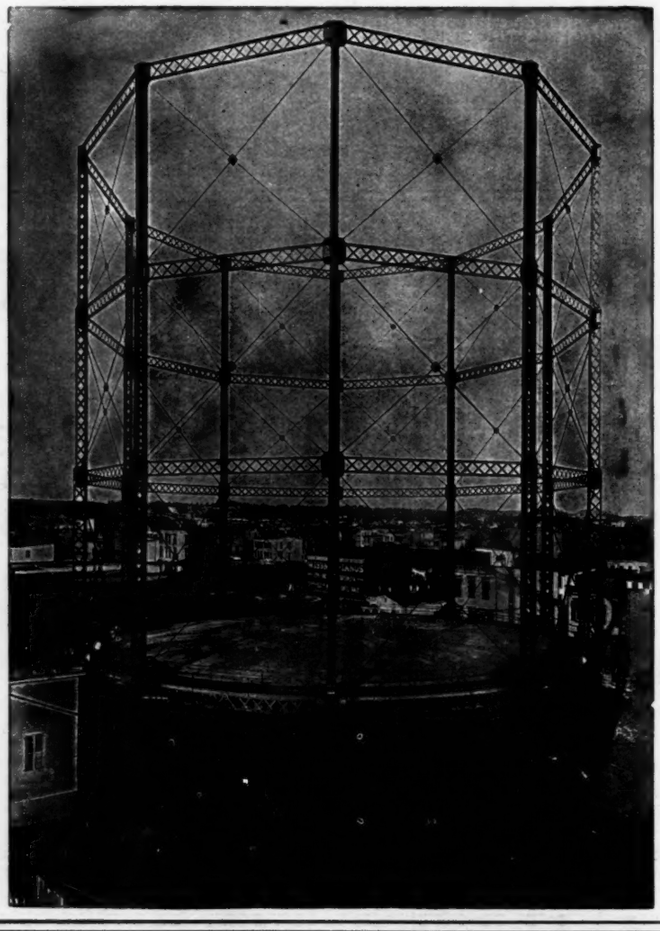

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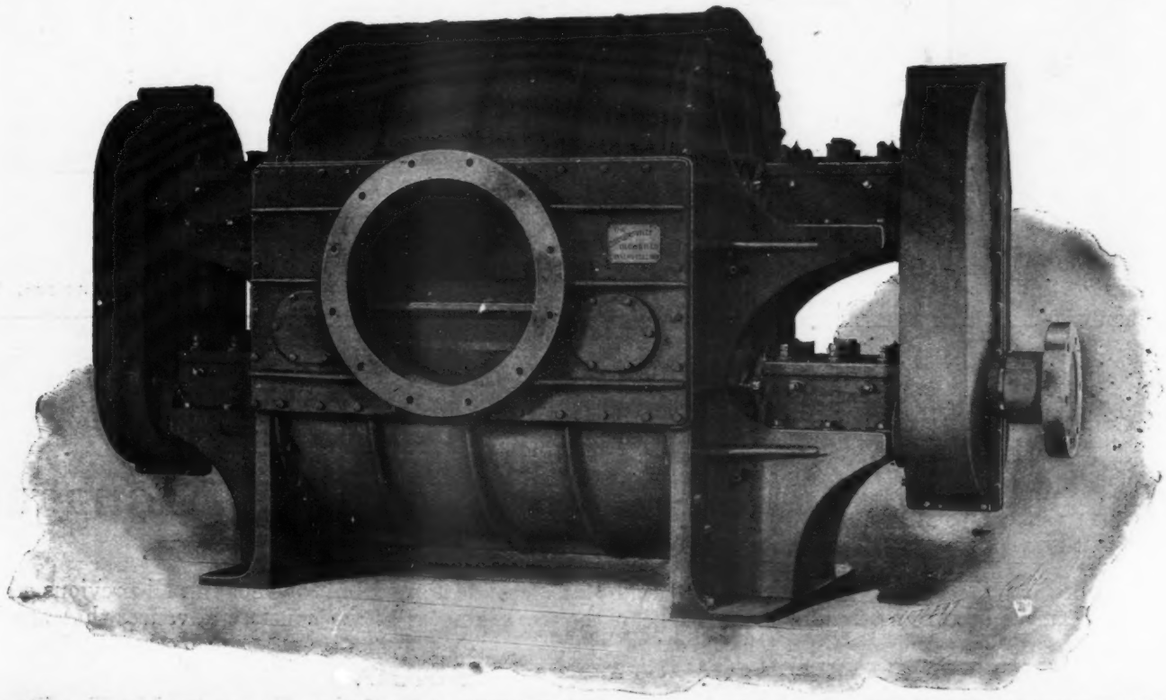

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